

---

**WSDOT NPDES Municipal Stormwater Permit  
BMP Effectiveness Monitoring Status Report (S7.C and S7.D)  
Water Years 2012-2015**

---

October 2016

Prepared by

Stormwater and Watersheds Program  
Washington State Department of Transportation

## **Author and Contact Information**

Washington State Department of Transportation

Stormwater and Watersheds Program

P.O. Box 47332

Olympia, WA 98504-7332

 [www.wsdot.wa.gov/environment/waterquality/default.htm](http://www.wsdot.wa.gov/environment/waterquality/default.htm)

*Any use of product or firm names in this publication is for descriptive purposes only and does not imply endorsement by the author or the Departments of Transportation.*

*Materials can be provided in alternative formats by calling the ADA Compliance Manager at 360-705-7097.*

*Persons who are deaf or hard of hearing may contact the above number via the Washington Relay Service at 7-1-1.*

## Stormwater Monitoring Report

---

### BMP Effectiveness Evaluation Water Years 2012-2015

**Approved by:**

I certify, under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for willful violations.

Signature: \_\_\_\_\_

Megan White, Director, WSDOT Environmental Services Office

Date: \_\_\_\_\_

Signatures are not available on the Internet version.

WSDOT = Washington State Department of Transportation

---

## Acknowledgements

---

WSDOT would like to express special thanks to the following individuals and organizations for their comments, insights, and contributions, which were invaluable in the development of this annual monitoring report.

- AmTest Laboratories, Kirkland, WA
- Heidi Wachter, Cardno, Inc., Seattle, WA
- Bryan Berkompas, Cardno, Inc., Seattle, WA
- Mingta Lin, Pyron Environmental, Inc., Olympia, WA
- Laboratory Data Consultants, Carlsbad, CA

WSDOT would also like to extend special thanks and appreciation to staff in the department's region maintenance offices that assisted monitoring efforts in the field.

WSDOT Stormwater and Watersheds Program field and data management teams deserve special acknowledgement for the long hours and extra effort they devoted to data collection and developing information for this report.

---

# Contents

---

Acknowledgements.....	ii
1 Introduction .....	1
1.1 Permit Overview .....	1
1.2 Monitoring Requirements (S7.C and S7.D) .....	1
1.3 Monitoring Schedule.....	1
2 Monitoring Program Implementation .....	3
2.1 Site Selection Strategy .....	3
2.1.1 Property Ownership.....	3
2.1.2 Site Representativeness.....	3
2.1.3 Personnel Safety .....	4
2.1.4 Site Accessibility.....	4
2.1.5 Equipment Security.....	5
2.1.6 Discharge Measurement Capability.....	5
2.1.7 Site Design Limitations.....	5
2.2 Resource and Logistical Constraints .....	6
2.3 BMP Effectiveness Monitoring Sites.....	7
2.4 Highway Runoff Characterization and BMP Effectiveness Study Design .....	9
2.4.1 Time of Concentration .....	12
2.4.2 Monitoring Site Set-Up and Sampling Design Details.....	12
3 Sampling and Monitoring Procedures .....	17
3.1 Monitoring Stations .....	17
3.1.1 Precipitation Measurement.....	17
3.1.2 Temperature Measurement .....	17
3.2 Weather Tracking.....	18
3.3 Sampling Parameters .....	19
3.4 Sampling Methods .....	19
3.5 Station Maintenance.....	20
3.6 Equipment Decontamination.....	20
3.7 Staff Roles and Responsibilities .....	21
4 Quality Assurance and Quality Control.....	22
5 Monitoring Results.....	23
5.1 BMP Monitoring.....	23
5.2 Sampling Logistics and Challenges.....	23

5.3	Stormwater Sample Collection .....	24
5.4	Monitoring Trends .....	25
5.5	Changes to the Monitoring Program .....	26
5.6	Lessons Learned .....	28
5.7	Projected Work and Future Monitoring Projects .....	29
	Glossary .....	30
	Literature Cited .....	32
	Acronyms, Abbreviations, and Units of Measurement .....	34
	Acronyms and Abbreviations .....	34
	Units of Measurement .....	35
	Appendix A: Analytical Data .....	36
	Appendix B: WY13-15 Storm Reports .....	91

---

## List of Tables

---

Table 1	Highway characterization monitoring sites. ....	8
Table 2	Storm event criteria for BMP effectiveness monitoring. ....	18
Table 3	Sampling water quality parameters listed in order of priority.....	19
Table 4	Sampling methods overview. ....	19

---

## List of Figures

---

Figure 1	Highway runoff and BMP effectiveness monitoring sites. ....	6
Figure 2	BMP locations and types for stormwater monitoring. ....	8
Figure 3	I-5 Everett BMP effectiveness monitoring study sites.....	10
Figure 4	I-5 Pilchuck Creek BMP effectiveness monitoring study sites.....	11
Figure 5	Cross section of the pavement edge collector. ....	13
Figure 6	Cross section of the downslope collectors. ....	13
Figure 7	Generalized sampling design. ....	14
Figure 8	I-5 Everett Highway and BMP effectiveness monitoring site. ....	15
Figure 9	I-5 Pilchuck Creek Highway and BMP effectiveness monitoring site. ....	16

---

# 1 Introduction

---

## 1.1 Permit Overview

On March 6, 2014, the Washington State Department of Ecology (Ecology) reissued a *National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge Municipal Stormwater General Permit* (permit) (Ecology 2014) to the Washington State Department of Transportation (WSDOT), effective April 5, 2014 to April 5, 2019. Under Special Condition S7 of the permit, WSDOT must continue a monitoring program to evaluate the effectiveness of highway vegetated filter strip (VFS) and modified VFS (MVFS) best management practices (BMPs), and develop a monitoring program to evaluate BMP effectiveness at three facilities (rest areas, maintenance facilities, or ferry terminals).

Under Special Conditions S7.C–D of the permit, monitoring reports are required for information collected at the department’s stormwater BMP effectiveness and monitoring sites. The following report helps satisfy these requirements and provides a summary of monitoring activities completed at VFS and MVFS BMP effectiveness monitoring sites from October 1, 2011, through September 30, 2015 (water years 2012-2015). This report also provides status on preparations to develop BMP effectiveness monitoring programs at WSDOT facility sites.

## 1.2 Monitoring Requirements (S7.C and S7.D)

In accordance with the permit, WSDOT must continue to evaluate the effectiveness of its highway VFS and MVFS stormwater treatment and hydrologic management BMPs. Monitoring must continue until statistical goals in the *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol – Ecology (TAPE)* (Ecology 2011) are met. If the statistical goals in TAPE cannot be met, the 2014 permit requires a maximum sampling effort of 35 sampling events.

In addition, WSDOT is developing a monitoring program to evaluate the effectiveness of stormwater treatment and hydrologic management BMPs at three maintenance facilities.

## 1.3 Monitoring Schedule

WSDOT submitted a *Quality Assurance Project Plan (QAPP) for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices* (WSDOT 2011a) to Ecology for approval on September 2, 2011. Ecology sent WSDOT a QAPP approval letter on September 16, 2011. This QAPP describes the objectives of the VFS and MVFS effectiveness monitoring programs and the procedures used to assure the quality and integrity of collected data. The QAPP also identifies project timelines and schedule.

Under the 2009 permit, WSDOT was required to fully implement the stormwater BMP effectiveness monitoring program no later than September 6, 2011. However, unanticipated challenges, including government hiring and equipment purchase freezes in effect through early summer 2011, delayed implementation of the monitoring program.

On October 20, 2011, as required under the 2009 permit, WSDOT notified Ecology that it would be unable to fully comply with monitoring program implementation timelines.

In a letter to Ecology on January 13, 2012, WSDOT proposed a revised schedule and phased approach for initiating the BMP effectiveness monitoring component of its program. The phased approach provided time for the iterative learning and adaptation necessary to fully and successfully implement the program. The letter proposed sampling at one BMP monitoring site beginning May 1, 2012, with the remainder of the sites operational by June 15, 2012. Ecology concurred, and WSDOT successfully met the revised timelines and schedule.

From 2013 to 2015, WSDOT submitted BMP effectiveness monitoring reports (WSDOT 2013, 2014a, and 2015). Those reports describe the development and status of the program through the first three years of monitoring. This report updates information from the previous reports. [Appendix A](#) summarizes BMP stormwater sampling data from WY12 through WY15.

---

## 2 Monitoring Program Implementation

---

### 2.1 Site Selection Strategy

The first step in selecting BMP effectiveness evaluation sites was a thorough review of the monitoring program's objectives and permit requirements. WSDOT used the program's objectives and permit requirements to establish the number and types of sites needed for monitoring.

Guidance from the California Department of Transportation (Caltrans 2003) and the following evaluation criteria helped ensure WSDOT selected the most appropriate sites:

- Property ownership
- Site representativeness
- Personnel safety
- Site accessibility
- Equipment security
- Discharge measurement capability
- Site design limitations

#### 2.1.1 *Property Ownership*

Only properties owned and operated by WSDOT were considered during the site evaluation and selection process.

#### 2.1.2 *Site Representativeness*

Monitoring was required from two treatment BMPs, at no less than two sites per BMP. Screening criteria for representativeness meant study sites had to be minimally influenced by unique contributing sources of pollution. The following factors were important in assessing BMP effectiveness site locations:

- Long-Term Location – Based on information available during the site selection process, sites that had the potential to be developed or redeveloped in the near future were avoided.
- Uniform Flow – Runoff flows need to be well mixed, but not turbulent. Sites with slopes greater than 33 percent or slopes with abrupt grade changes were not selected.
- Erosion Potential – Extremely steep slopes or cut and fill areas where the land surface had not been stabilized were avoided.

- Tidal and Backwater Influences – Backwater or tidally-influenced sites were not selected.
- High Groundwater Table – A high groundwater table sometimes influences stormwater runoff if the groundwater reaches the surface and mixes with runoff. Therefore, attempt was made to avoid sites where groundwater influence was suspected or confirmed.
- Illegal Discharges – Sites where there were signs of illegal discharges or dumping of wastes were not considered.
- Surrounding Land Uses – Sites where the surrounding land use heavily influenced the quality of runoff through aerial deposition were avoided.

### 2.1.3 *Personnel Safety*

For any WSDOT highway project, staff safety is a high priority. Hazards from traffic, explosive or toxic gases, poor footing on slopes, slippery conditions, and poor visibility due to adverse weather or night work were minimized or avoided whenever possible.

The following site attributes expose monitoring field teams to potentially unsafe conditions:

- Sites located along a highway shoulder
- Sites that require traffic control
- Sites with poor access
- Sites close to waterways

To minimize the effect(s) of these hazards, members of the field team had to be capable of performing all tasks required for sample collection and be familiar with WSDOT's *Safety Procedures and Guidelines Manual* (WSDOT 2016) and *Work Zone Traffic Control Guidelines* (WSDOT 2014b). Site-specific Health and Safety Plans were developed for each monitoring site to further minimize the effect of these hazards.

### 2.1.4 *Site Accessibility*

Monitoring sites were selected to provide safe and feasible access. Highway shoulder width and site visibility from the roadway had to be sufficient to allow safe access for vehicles leaving and reentering the highway.

Due to the nature of highway BMP effectiveness monitoring, locating sites away from the highway shoulder was not an option. To improve fieldwork safety, staff sought access to freeway sites from frontage roads or other off-site locations. When sample timing or site retrofit needs made off-site access impracticable, field teams followed WSDOT safety guidelines and minimized time spent working along the highway.

To make sure personnel could quickly locate and access monitoring sites, site-specific Health and Safety Plans were developed to include a description of parking and work zone safety procedures. Information in the Health and Safety Plans included lists of physical and biological hazards, standard emergency procedures, site maps, and directions.

### *2.1.5 Equipment Security*

Selected sites had to provide adequate level space for monitoring station installation in areas that did not stand out visually. Data collection equipment was installed in locked metal enclosures on level ground or concrete platforms to reduce the risk of tampering.

Locked metal enclosures provided a secure location as well as protection from wind, rain, and snowfall. Signs applied to the outside of the enclosures identified the monitoring stations as WSDOT property.

### *2.1.6 Discharge Measurement Capability*

Monitoring sites were selected in locations that allowed discharge measurement and automatic sample collection. In order to monitor sheet flow runoff from WSDOT highways, conveyance systems were constructed to collect, direct, and measure stormwater runoff from sections of the roadway. Stormwater monitoring conveyance systems provided suitable water depth for measuring discharge and collecting stormwater samples during storm events.

### *2.1.7 Site Design Limitations*

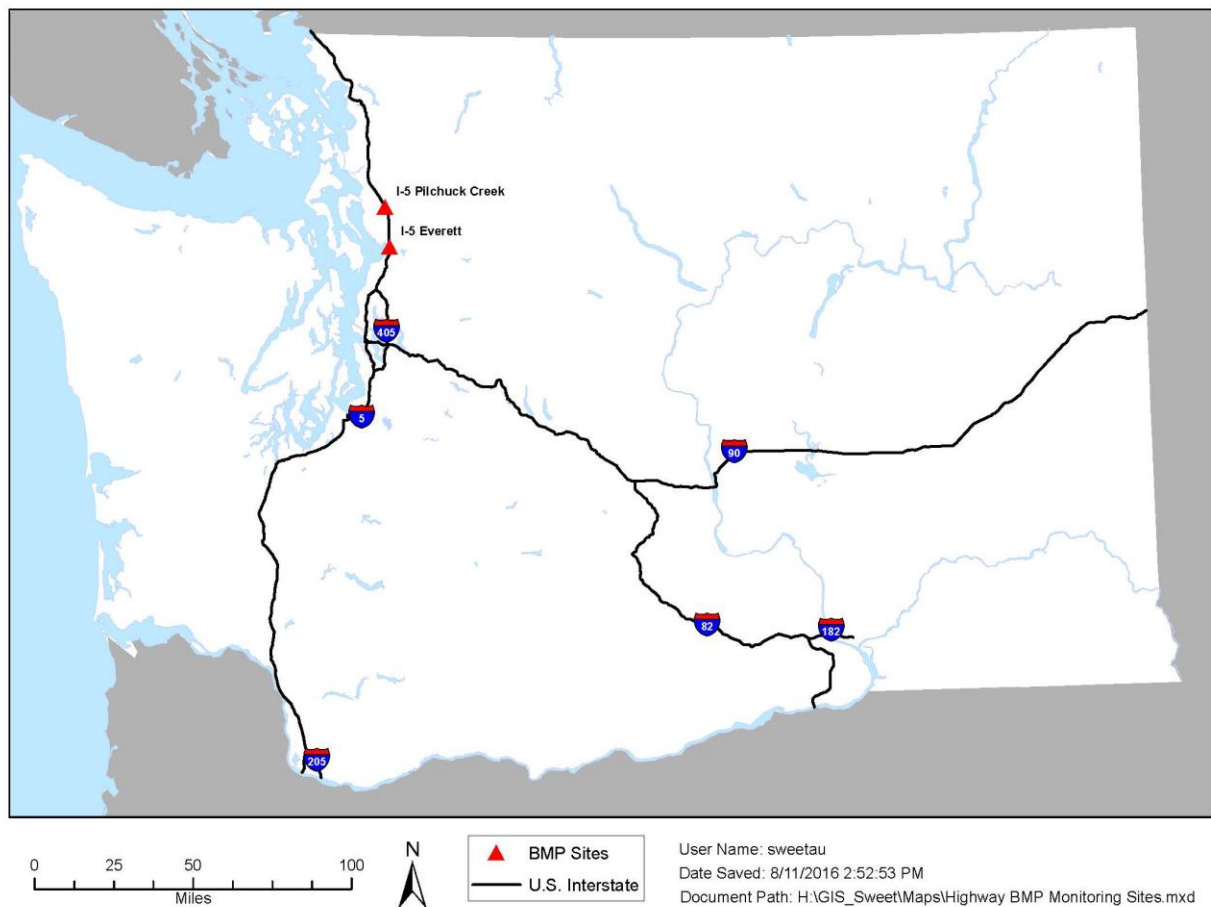
To meet permit requirements, BMP monitoring stations had to be established to enable collection of water quality and quantity data from influent and effluent sampling locations. The following site design limitations were considered when establishing monitoring stations for BMP effectiveness evaluation:

- The physical space needed for monitoring infrastructure and data collection platform (DCP) establishment.
- The monitoring site design needs that would provide easy access for BMP influent and effluent sampling.
- Monitoring equipment and site infrastructure that would need to be installed to enable accurate flow measurements and reduce the amount of maintenance required.

## 2.2 Resource and Logistical Constraints

To maximize resources and address logistical challenges in implementing the stormwater BMP effectiveness monitoring program, WSDOT staff developed a strategy to optimize the number of monitoring locations needed to meet permit requirements. To address logistical challenges and reduce mobilization costs, monitoring study sites were localized to reduce travel time and associated costs.

Figure 1 shows the location of the highway runoff characterization and BMP effectiveness monitoring sites.



**Figure 1** BMP effectiveness monitoring sites.

## 2.3 BMP Effectiveness Monitoring Sites

WSDOT combined permit-required highway runoff characterization and BMP effectiveness monitoring sites at two locations along Interstate 5 (I-5). The following types of biofiltration BMPs were selected for monitoring:

- Vegetated filter strips (VFS)
- A compost-amended vegetated filter strip (CAVFS)
- Experimental or modified vegetated filter strips (MVFS)

Vegetated filter strips (VFS) are sloping land areas with planted vegetation and amended soils used to treat stormwater sheet flow from roads and highways. These BMPs function by slowing runoff velocities, filtering sediment and other pollutants, and providing some biologic uptake and infiltration into underlying soils (WSDOT 2014c).

A basic *vegetated filter strip* (VFS) is a compacted roadside embankment that is hydroseeded with an established grass seed mix. A *compost-amended vegetated filter strip* (CAVFS) is a variation of the basic VFS that incorporates soil amendments (compost) into the top layer of the soil to enhance infiltration characteristics, increase surface roughness, and improve plant growth and cover (WSDOT 2014c).

Basic VFSs and CAVFSs are preferred filter strip designs. Both BMPs are also approved for use by the Washington State Department of Ecology (Ecology) and described in detail in the *Highway Runoff Manual* (WSDOT 2014c).

A *modified vegetated filter strip* (MVFS) is an experimental BMP that has not yet received approval from Ecology. The MVFS includes a three-inch compost blanket that is applied to the surface of the soil. In comparison to CAVFS, the MVFS does not require heavy equipment to till compost into the top layer of the soil, making the cost of installation less expensive.

The MVFS design reduces costs for construction because compost blanket applications require minimal ground disturbance, fewer traffic impacts, and less traffic control. In addition, compost blankets may be applied on steeper slopes, over broader areas, and as erosion control earlier in the construction process. The MVFSs can also be applied in limited spaces, such as urban areas, where CAVFS installations are usually not possible.

WSDOT installed two VFS/MVFS effectiveness study sites on roadside embankments adjacent to I-5, one northbound between mileposts 197.27 and 197.35 near Everett and one southbound I-5 between mileposts 210.71 and 210.85 near Arlington. As required by the permit, these sites provide paired studies for comparison of low-impact development (LID) treatment approaches. A CAVFS was installed at the southbound I-5 location (milepost 210.78) for additional comparison.

Table 1 provides a list of the BMPs, with their locations, average slopes, and average grades. Figure 2 shows the BMP effectiveness study site locations.

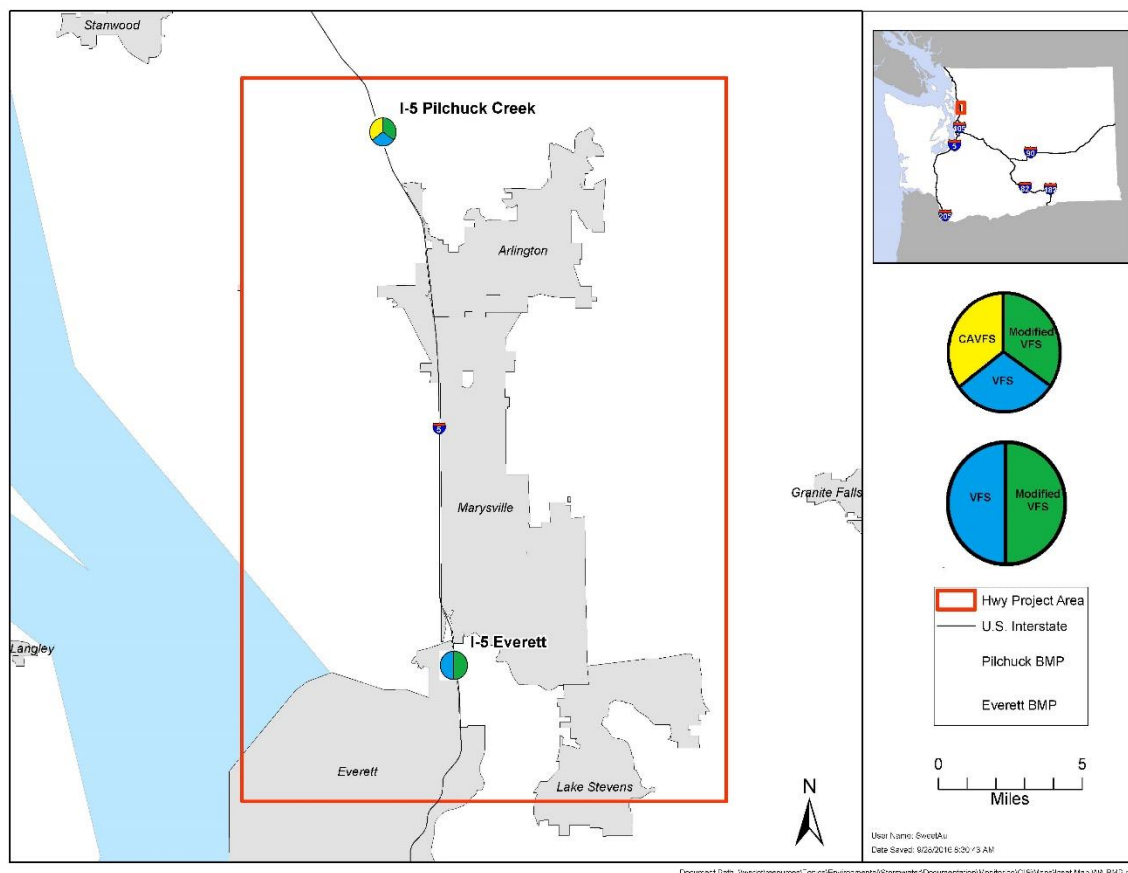
**Table 1 Highway characterization monitoring sites.**

BMP Study	Location	BMP Type	Traffic Designation <sup>[1]</sup>	Average Slope (H:V) <sup>[2]</sup>	Average % Grade
I-5 VFS Study	I-5, Everett MP197.27	Basic VFS	Highly urbanized 126,000 AADT	3.70:1	27
	I-5, Everett MP 197.35	Modified VFS		3.85:1	26
	I-5 Pilchuck MP 210.71	Basic VFS	Urbanized 76,000 AADT	4.00:1	25
	1-5 Pilchuck MP 210.78	CAVFS		3.85:1 <sup>[3]</sup>	26
	I-5 Pilchuck MP 210.85	Modified VFS		3.70:1	27

[1] Annual average daily traffic (AADT). AADT values were obtained from the WSDOT "Annual Traffic Report" (WSDOT 2014d).

[2] Horizontal: Vertical (H:V).

[3] Estimated slope.



**Figure 2 BMP locations and types for stormwater monitoring.**

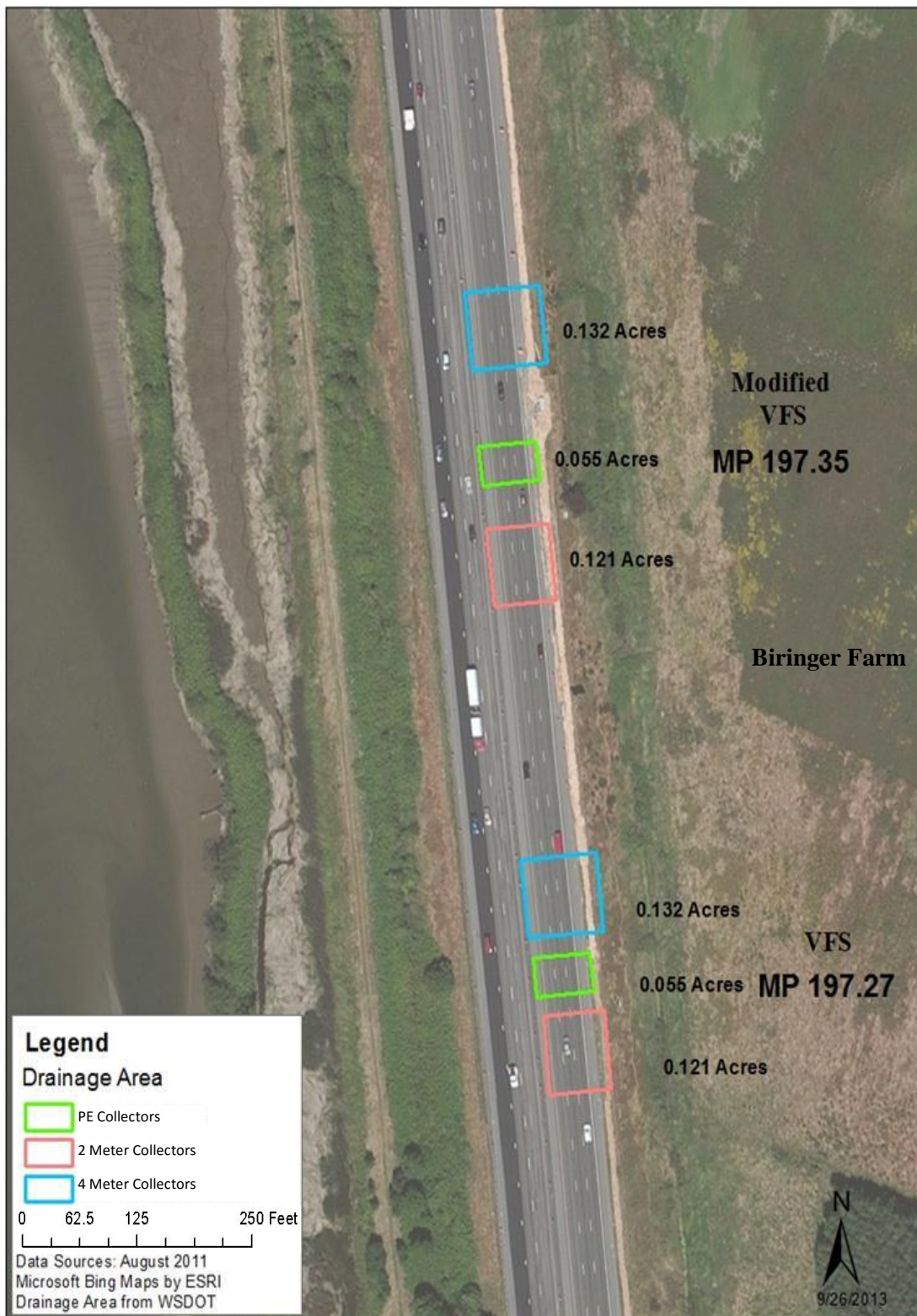
## **2.4 Highway Runoff Characterization and BMP Effectiveness Study Design**

The I-5 BMP effectiveness studies evaluate and compare highway runoff treatment performance of VFS, MVFS, and CAVFS designs. Three stormwater collectors (6-inch-diameter, high-density polyethylene pipes) are positioned along each VFS and MVFS. Collectors are located at the edge of pavement, 6.6 feet (2 meters), and 13.1 feet (4 meters) downslope from the pavement edge. WSDOT staff will evaluate and compare treatment performance from the pavement edge (influent samples) and downslope collection points (effluent samples).

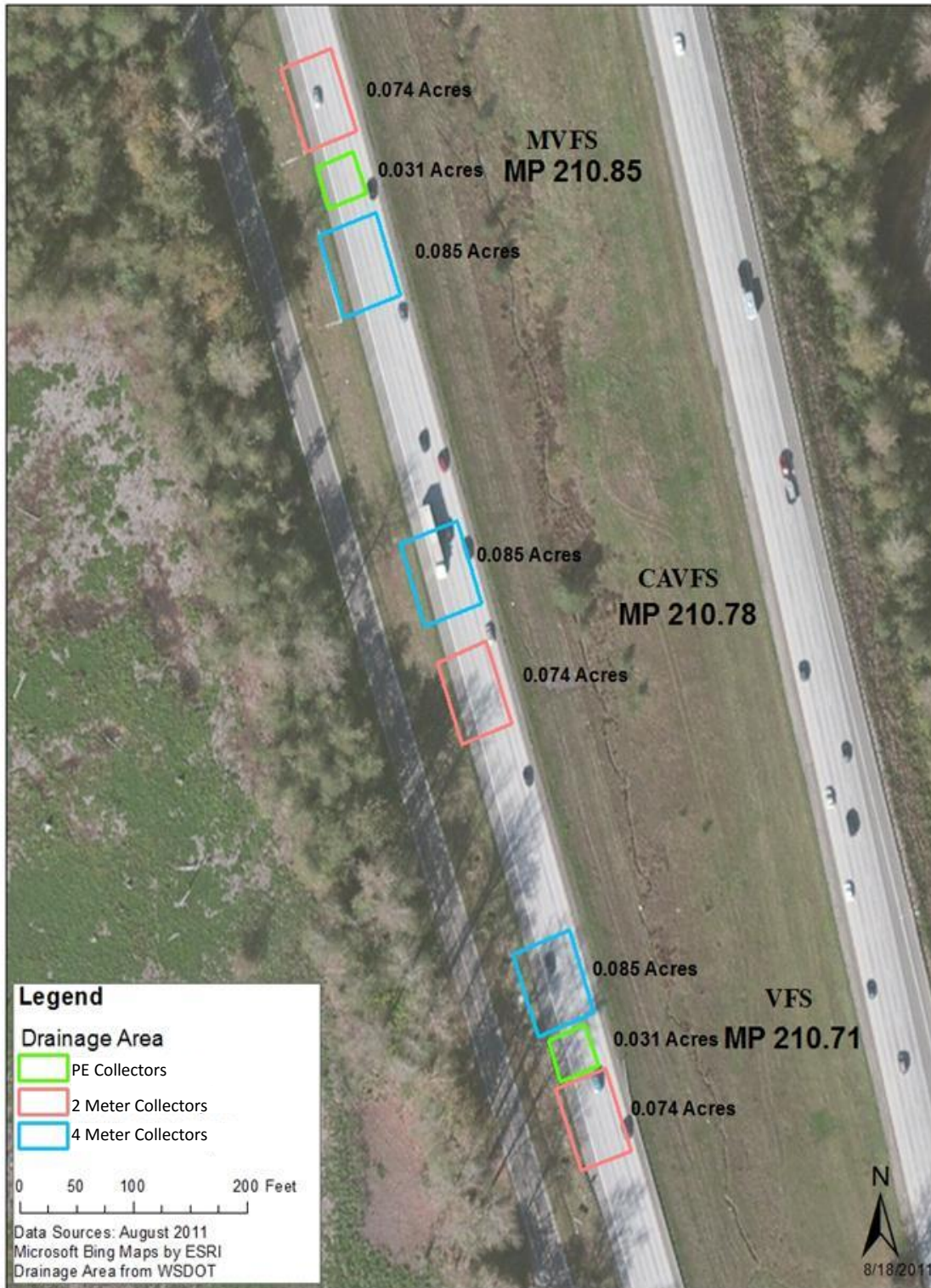
As part of the study's sampling design, WSDOT staff established effluent sample collection points 6.6 feet downslope because highways in highly urbanized areas often have limited space to locate stormwater treatment along the road shoulder. Some studies suggest much of the flow reduction and water quality treatment performance of VFSs may occur close to the edge of pavement (Ebihara et al., 2009; Kaighn and Yu 1996).

The effluent collection points located 13.1 feet downslope are included in this study to further evaluate the treatment performance of the BMPs on the road shoulder embankment. Sampling from the 6.6- and 13.1-foot locations provides an opportunity to assess to what extent, if any, performance is enhanced by increasing the distance.

Aerial views of the I-5 Everett and I-5 Pilchuck Creek BMP effectiveness monitoring study sites are shown in Figures 3 and 4.



**Figure 3 I-5 Everett BMP effectiveness monitoring study sites.**



**Figure 4** I-5 Pilchuck Creek BMP effectiveness monitoring study sites.

### 2.4.1 Time of Concentration

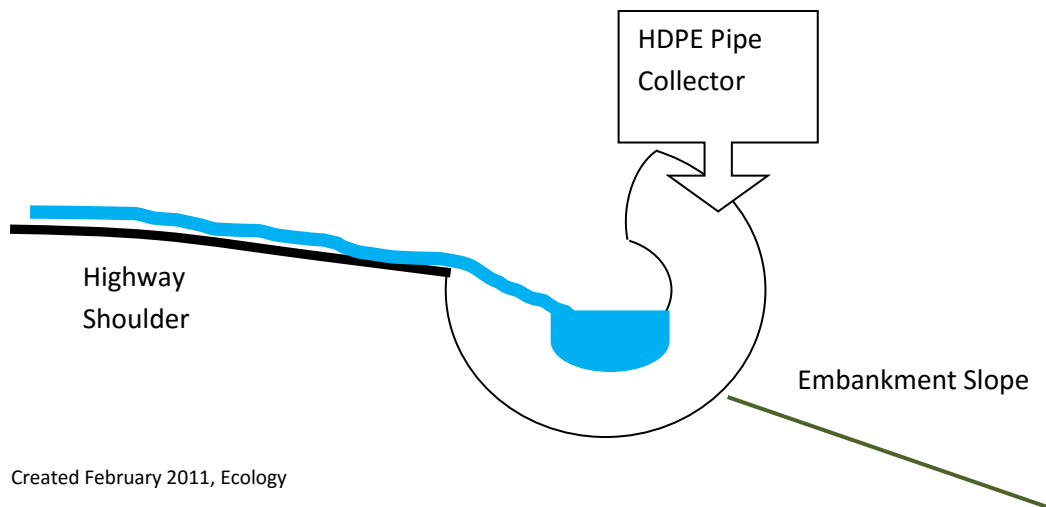
WSDOT staff programmed automatic flow-weighted composite samplers to begin sampling as early in a storm runoff event as feasible. Sampling continued as long as flow was present and precipitation met inter-event criteria for up to 24 hours. For BMP effectiveness monitoring sites, time of concentration is the time necessary for surface runoff to reach the edge of pavement collector from the hydraulically most distant point of each drainage area. Time of concentration estimates provide a baseline to ensure pacing of the monitoring equipment is set to obtain a representative sample and to evaluate whether contributions from the entire basin are represented.

Each monitoring site's times of concentration were based on a range of rainfall depths typical in the state of Washington. Flow lengths were estimated from hydraulics reports, field estimates, as-built drawings, aerial photography, or WSDOT's GIS Workbench (WSDOT 2011b). Drainage areas were calculated by multiplying the flow length by the length of the pavement edge collectors.

For further information regarding each site's time of concentration, refer to the *Quality Assurance Project Plan for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices* (WSDOT 2011a).

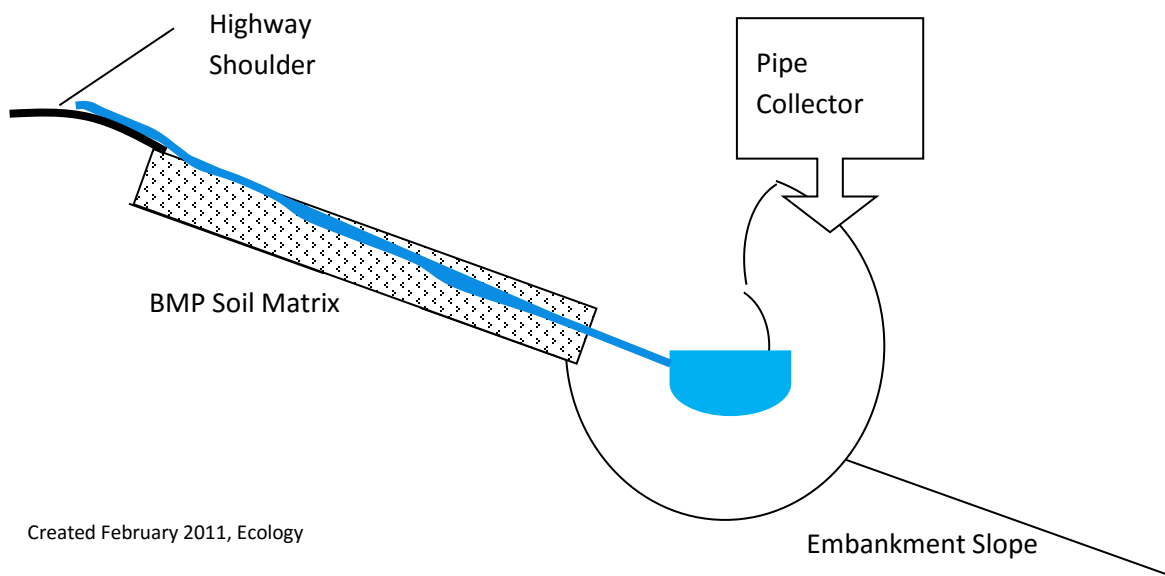
### 2.4.2 Monitoring Site Set-Up and Sampling Design Details

WSDOT staff installed six-inch, high-density polyethylene (HDPE) pipe collectors along the pavement at the I-5 Everett and I-5 Pilchuck Creek highway runoff characterization and BMP effectiveness monitoring sites. Staff buried pipes and mortared them to the edge of the pavement. Collector pipes slope slightly downhill to promote directional flow for measurement. Figure 5 shows the pavement edge collector pipe and highway shoulder in cross section.



**Figure 5 Cross section of the pavement edge collector.**

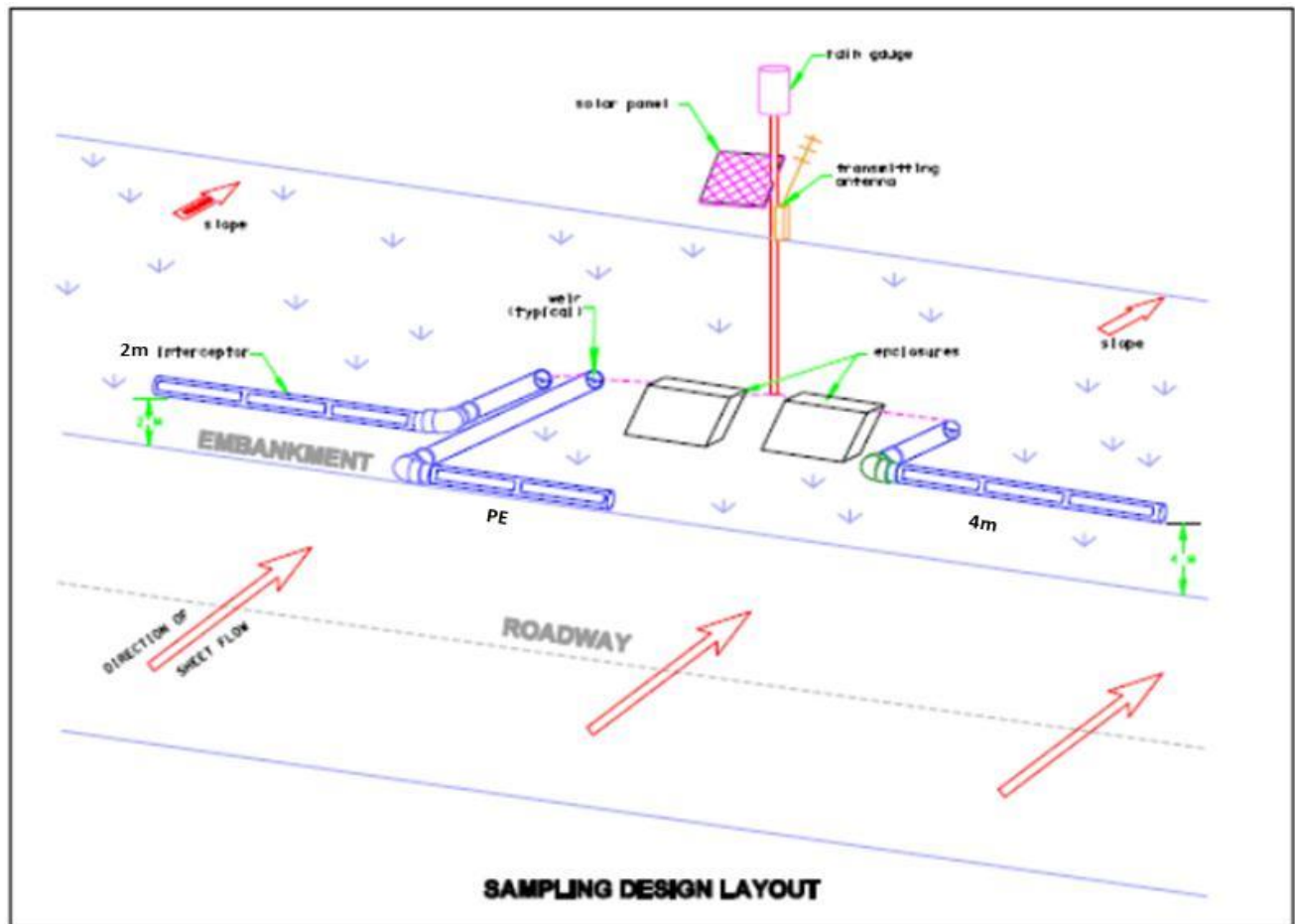
Collector pipes installed at 6.6 feet and 13.1 feet along the embankments were recessed into the surface of the soil and positioned to collect surface runoff flowing through the BMP from the edge of pavement. Similar to the pavement edge collector, the 6.6- and 13.1-foot collectors were sloped slightly to promote directional flow for measurement. Figure 6 shows the downslope collector in cross section.



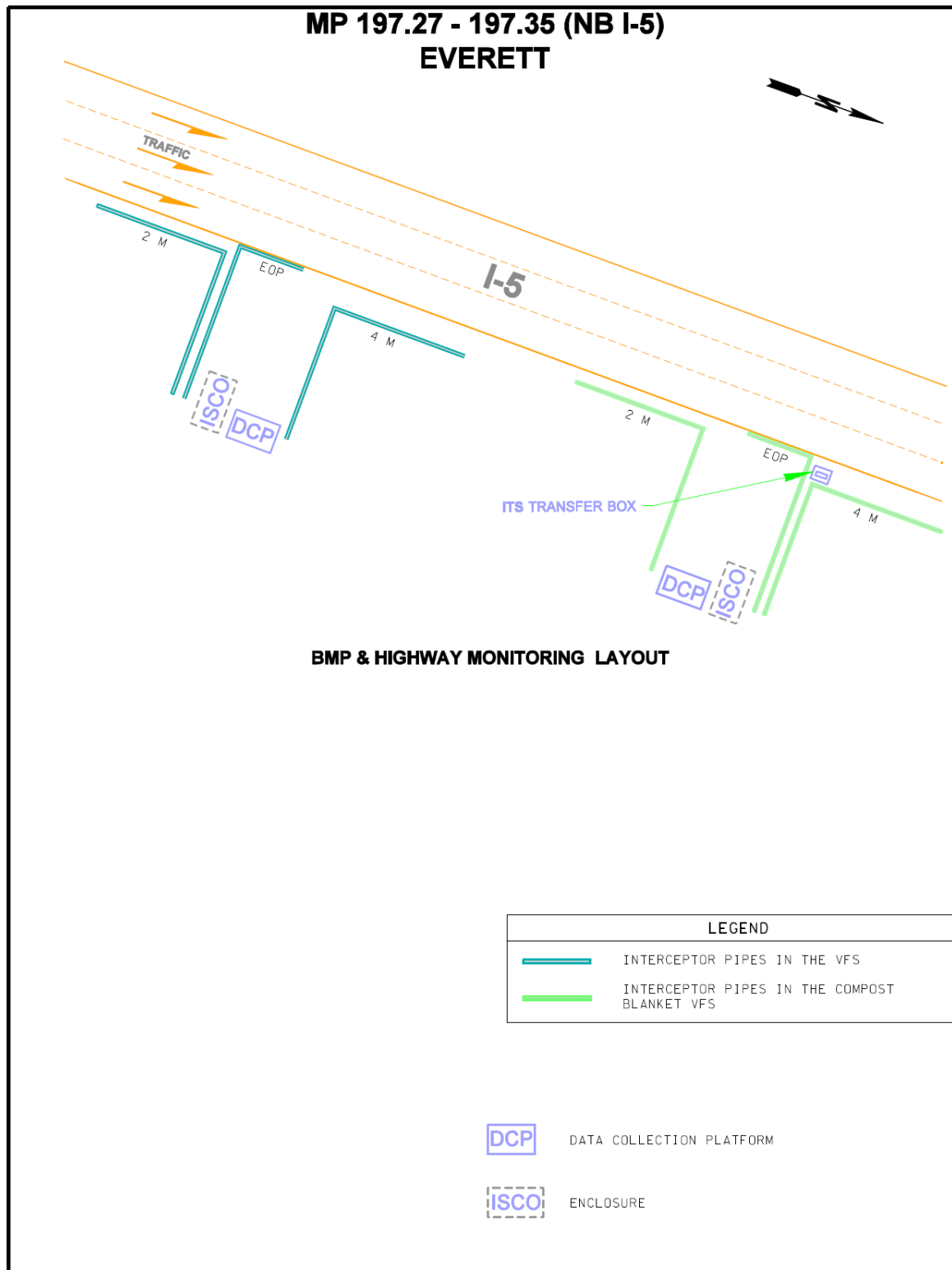
**Figure 6 Cross section of the downslope collector.**

Figure 7 shows a generalized drawing of a BMP effectiveness monitoring site. The diagram illustrates how collectors were positioned to collect sheet flow runoff from the surface of the highway and downslope through the VFS. The data collection platform (DCP) with rain gage, solar panel, transmitting antennae, Global Positioning System (GPS), and enclosures was installed at the lower end of the roadside embankment.

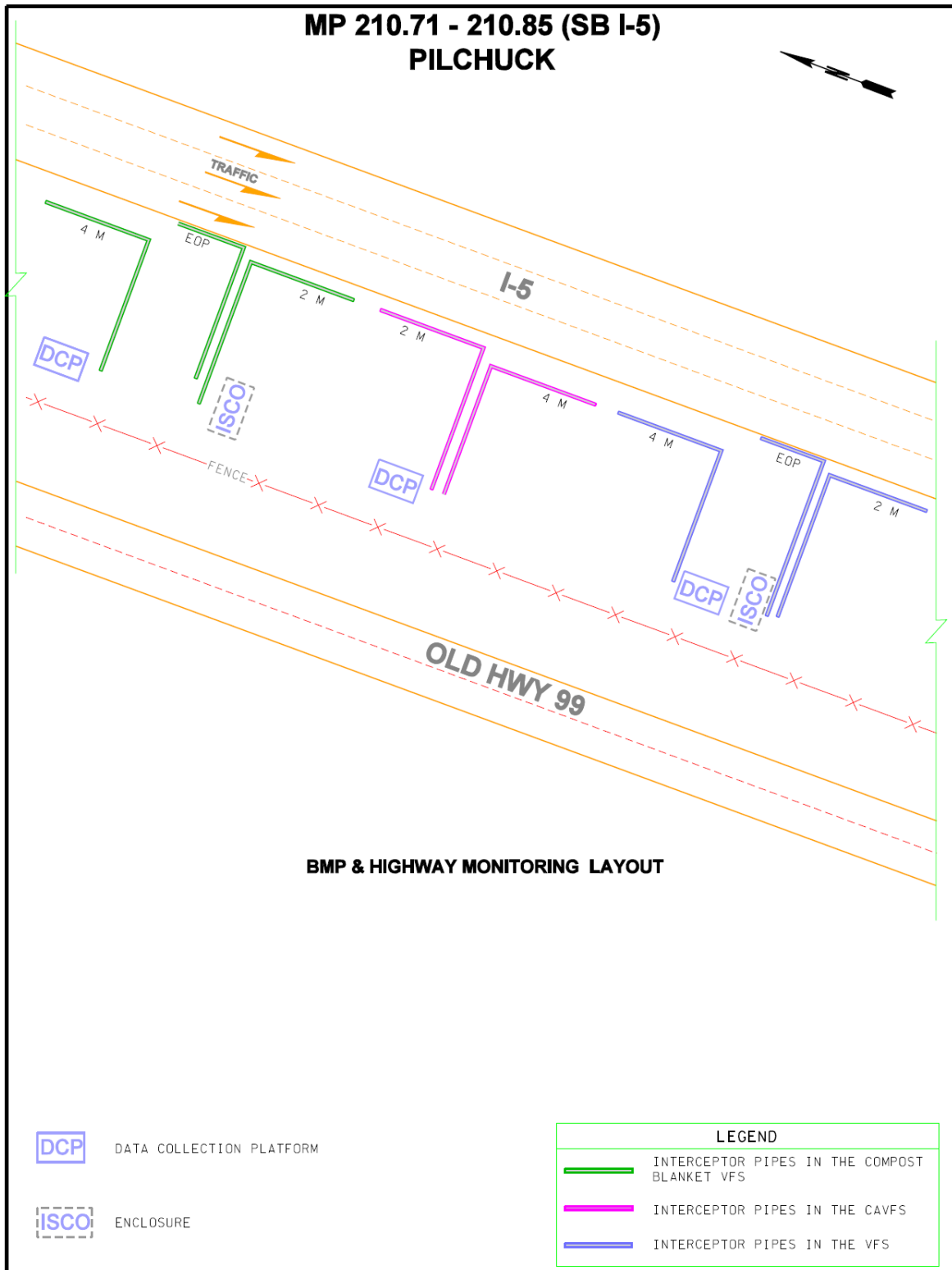
**Figure 7 Generalized sampling design.**



Figures 8, and 9 depict the I-5 Everett, I-5 Pilchuck Creek monitoring sites.



**Figure 8 I-5 Everett BMP effectiveness monitoring site.**



**Figure 9 I-5 Pilchuck Creek BMP effectiveness monitoring site.**

---

## 3 Sampling and Monitoring Procedures

---

### 3.1 Monitoring Stations

Monitoring stations at best management practice (BMP) effectiveness monitoring sites typically include an equipment enclosure with lock, Global Positioning System (GPS), antenna, solar panel, and rain gage. The antenna, solar panel, and rain gage are mounted on a mast that is attached to the side of the equipment enclosure.

The equipment enclosure houses a data logger; refrigerated automatic sampler; sample tubing; stage measuring devices, including a depth pressure transducer (PT) and compact bubble sensor (CBS); and a 12-volt battery. Sample tubing runs from the automatic sampler out of the equipment enclosure to the designated sampling point through a protective conduit. The PT wires as well as the CBS line run through conduit to a stilling well where stage and temperature are recorded. The locked enclosure provides a secure location for equipment as well as protection from wind, rain, and snowfall.

#### 3.1.1 *Precipitation Measurement*

At each monitoring station, WSDOT installed a pole-mounted, tipping-bucket rain gage to accurately measure on-site rainfall. Rain gages were installed, using National Weather Service criteria as guidance (NWS 2010), where no trees, buildings, overpasses, or other objects would obstruct or divert precipitation. Rain gage data is collected every 15 minutes and stored in the data logger's memory. WSDOT uses these data, transmitted telemetrically to a WSDOT database, to track and record site-specific precipitation measurements.

#### 3.1.2 *Temperature Measurement*

Water temperature measurements are recorded at each of the BMP effectiveness monitoring sites to fulfill permit requirements and deactivate or discontinue sampling in the event of freezing or near freezing conditions. Temperature sensor data are recorded by the data logger every 15 minutes and transmitted hourly to WSDOT's database. Sample event tables in [Appendix B](#) provide minimum and maximum temperature values recorded during sampling events.

## 3.2 Weather Tracking

WSDOT uses weather information—from satellite imagery, prediction models, the National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS), and private forecasters—to forecast potentially qualifying storm events on a daily basis. As candidate storms approach, radar observations and hourly reports from land-based weather stations help track and evaluate storm potential. Staff use telemetered data transmitted from individual monitoring stations to track the progress of a storm event and the beginning of runoff. The stormwater monitoring team uses this information to direct field team deployments for sample collection.

To qualify, storms have to meet rainfall depth and antecedent dry period criteria. Table 2 lists storm event criteria in effect for BMP effectiveness monitoring sites through WY15.

**Table 2 Storm event criteria for BMP effectiveness monitoring.**

Criteria	BMP Effectiveness Monitoring
Monitoring Period	Year round
Rainfall Depth	0.15" minimum; no fixed maximum
Rainfall Duration	1-hour minimum; no fixed maximum
Antecedent Dry Period	< 0.04" rain in the previous 6 hours
Inter-event Dry Period	Not specified
Minimum Intensity	Range of rainfall intensity <sup>[1]</sup>

[1] To assess performance on an annual average basis and performance at the peak design rate, samples should be collected over a range of rainfall intensities (Ecology 2011).

### 3.3 Sampling Parameters

Sampling requirements listed in S7.E.5 of the 2009 permit and Ecology's TAPE (Ecology 2009a and 2011) specify parameters for BMP effectiveness monitoring. These parameters are listed in Table 3, in the priority order of analysis. If insufficient sample volume existed, WSDOT processed samples in order of priority taking into account volume requirements for laboratory analysis.

**Table 3 Sampling water quality parameters listed in order of priority.**

<b>BMPs</b>
Total suspended solids (TSS)
Particle size distribution (PSD)
pH
total phosphorus
orthophosphate
hardness
Copper (Cu), zinc (Zn) (total)
Cu, Zn (dissolved)

The 2009 permit (Ecology 2009a) required sediment sampling for BMP effectiveness monitoring sites. However, the BMPs the department selected for monitoring (i.e., basic VFS, CAVFS, and MVFS) are infiltration-type BMPs that use grass and soil, or compost, grass, and soil, as filtration media. Sediment samples from these BMPs are not collected since there is no technique to ensure collected sediment represents only stormwater-carried sediments and not components of the soil or compost. Ecology approved this deviation from permit requirements during the QAPP approval process.

### 3.4 Sampling Methods

BMP effectiveness monitoring sites were established to measure stormwater quality and quantity. Table 4 lists parameter categories, sampling frequency, and methods.

**Table 4 Sampling methods overview.**

<b>Parameter Category</b>	<b>Sampling Frequency</b>	<b>Sampling Method</b>	<b>Telemetered Data?</b>
Rainfall	Continuous, year round	Rain gage	yes
Stage (flow)	Continuous, year round	Stage measuring device	yes
Temperature	Continuous, year round	Stage measuring device	yes
Chemical	Discrete storm events	Autosampler	no

For further information regarding field work activities, sample processing details, and analytical requirements for BMP effectiveness evaluation, see the *Quality Assurance Project Plan for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices* (WSDOT 2011a).

### 3.5 Station Maintenance

WSDOT staff provided regular station maintenance every six to eight weeks early in the project, and now maintain sites on a three-week schedule. Monitoring staff perform a visual inspection of the monitoring site to identify possible damage to equipment and any new or unsafe conditions. Staff check equipment enclosures for signs of tampering or forced entry. Staff inspect and clean outlet pipes, sampling basins, and the conveyance system to ensure the monitoring station is in good condition prior to a sampled storm event. Field staff follow this inspection and cleaning procedure to ensure representative data collected from the system is unaffected by accumulated debris and sensor drift.

Following the *Standard Operating Procedure for Equipment Maintenance and Cleaning* (WSDOT 2011c), field staff conduct station checks that include, inspections, testing, and replacement of worn or missing parts. Monitoring staff inspect internal wires and cables to evaluate wear and ensure cable connections to the data logger are in good condition. Station antennae declinations and bearings are checked, and solar panels are cleaned to remove accumulated debris. When servicing or calibrating of scientific equipment at monitoring stations is required, trained technicians follow manufacturers' specifications and conduct servicing and calibration of equipment on site or in a controlled environment, as appropriate.

### 3.6 Equipment Decontamination

Unless certified as precleaned from the equipment source, a contract lab decontaminates churners, sample containers, filters, or other materials that come into contact with sampled stormwater prior to each use. Intake tubing and pump head tubing are cleaned prior to installation and changed once each year or as necessary.

For more detailed descriptions of decontamination procedures, see the *Quality Assurance Project Plan for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices* (WSDOT 2011a).

### **3.7 Staff Roles and Responsibilities**

WSDOT uses Stormwater and Watersheds Program staff in the Headquarters (HQ) Environmental Services Office (ESO) and staff from the department's region offices to implement its monitoring programs. Eight staff from the HQ ESO played key roles in the stormwater monitoring strategy.

---

## 4 Quality Assurance and Quality Control

---

The *Quality Assurance Project Plan for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices* (WSDOT 2011a) includes a comprehensive description of quality assurance and quality control activities.

WSDOT implements quality control (QC) procedures through all phases of data collection and analyses. Quality control procedures include field collection and laboratory processing for all permit-required samples. Additionally, verification and validation of both field- and laboratory-generated data occur as part of data management activities. The quality of raw, unprocessed, and processed data is subject to review and management, including the following areas of work:

1. Field quality control

- Implementation of standard operating procedures
- Field instrument inspection, calibration, and maintenance
- Site water conveyance systems inspection and maintenance
- Collection of field notes and maintenance documentation
- Collection of composite field duplicate samples
- Collection of field equipment blanks

2. Laboratory quality control

- Laboratory instrument maintenance and calibration
- Analysis of laboratory duplicate/split samples
- Analysis of laboratory matrix spike and matrix spike duplicate samples
- Analysis of laboratory blanks and standards

3. Data management

- Hydrology and precipitation data verification
- Field data verification
- Correction of data gaps, anomalies, and use qualification for precipitation and hydrology data
- Laboratory data verification and validation
- Self-assessment and audit of project processes

---

## 5 Monitoring Results

---

### 5.1 BMP Monitoring

WSDOT collected water quality, hydrological, and meteorological data at vegetated filter strip (VFS) and modified VFS (MVFS) best management practice (BMP) effectiveness monitoring sites in water years 2012-2015 (WY12-WY15). [Appendix A](#) summarizes BMP stormwater sampling data, and [Appendix B](#) presents monitoring storm reports.

### 5.2 Sampling Logistics and Challenges

WSDOT field staff used storm event criteria and guidelines detailed in WSDOT's NPDES municipal stormwater permits and Ecology's Technical Assessment Protocol (TAPE) (Ecology 2011) to deploy resources for forecast qualifying storm events. Collecting BMP stormwater data was challenging due to the dynamic and unpredictable nature of storm forecasts and rainfall. Section 3.2 details the storm event criteria used to determine team deployments.

Sample collection requirements included a minimum of 10 equal-volume samples (aliquots)<sup>1</sup> collected during each sampled storm event and combined to create a single composite sample. For storm events lasting less than 24 hours, samples had to be collected for 75 percent of the storm hydrograph (by volume).<sup>2</sup> Storms were required to have a minimum of 0.15 inches of precipitation<sup>3</sup> (Ecology 2011).

Frequently, storm event patterns that meet one permit requirement contribute to not meeting another requirement. For example:

- Autosamplers are programmed based on forecast rainfall amounts and predicted volume of stormwater runoff. However, actual storm event rainfall and runoff volume often differ from forecast amounts. WSDOT uses industry standard remote autosamplers that collect sample aliquots based on the amount of discharge volume from the respective BMPs. WSDOT autosamplers can only hold a certain amount of stormwater, 9.4 liters (2.5 gallons), which limits the number of aliquots that can be

---

<sup>1</sup> Seven to nine aliquots may be accepted; however, the final report will include an explanation and justification as to why less than 10 aliquots were collected.

<sup>2</sup> A small number of events may contain storms capturing 70-74.9 percent of the hydrograph. These storms were collected due to being paired with multiple other qualifying events. The final report will document justification of inclusion for each of these storms.

<sup>3</sup> A small number of events may contain storms with 0.13 or 0.14 inches of precipitation. These storms were collected due to being paired with multiple other qualifying events. The final report will document justification for inclusion of each of these storms.

collected during a storm. With an event that produces greater than predicted amounts of runoff, autosamplers may fill prematurely, limiting their ability to capture 75 percent of a storm. Conversely, events that produce less than the predicted amount may fail to meet the 10 aliquot requirement set by TAPE and the permit.

- Rain-to-runoff patterns often differ based on many contributing variables including time between rainfall events and rainfall intensity. A storm event that occurs in close proximity to another event may display different surface runoff characteristics than a storm event occurring after weeks of no precipitation. In addition, a high-intensity, short-duration rain event will display different stormwater runoff dynamics than a low-intensity storm occurring over a long duration.

Despite the challenges in collecting qualified storm event samples, WSDOT successfully collected multiple events at all of the BMP sites. Field observations and data collection regarding site hydrology and soils (e.g., soil saturation levels, structure, and composition) conducted during the year improved sampling success by improving the predictability of runoff occurring from a forecasted storm event. WSDOT anticipates using field observations paired with consistent improvements in the understanding of site hydrology to further improve sampling efficacy.

### **5.3 Stormwater Sample Collection**

WSDOT is in the process of collecting enough stormwater samples to meet the permit and TAPE requirements. TAPE guidelines specify the number of samples, sampling procedures, and type of data assessment needed to meet the required statistical goals for BMP approval. If TAPE sampling and statistical goals are met, a final report will be compiled and submitted to Ecology. The final report will present the results and discussion of WSDOT's VFS BMP performance.

The number of overall sample events reported in previous years has decreased as WSDOT staff reassessed the hydrological validation process for sampled events. Some events previously validated were subsequently rejected as it was determined that the beginning of the storms were not sampled. Leaking weirs caused early runoff to not be measured by the monitoring equipment. These new rejections caused some of the sites to have a lesser number of events collected than reported in previous years.

[Appendix A and B](#) detail all storm event sampling dates and event mean concentrations for each parameter. The numbers of paired storm events sampled in WY12-WY15 at WSDOT's 14 BMP sample collection points are presented below:

**I-5 Everett, MP 197.27, VFS:**

- Eight events collected at site pavement edge (PE) (Everett 01)
- Three events collected 6.6 feet (2 meters) from PE (Everett 02)
- Eight events collected 13.1 feet (4 meters) from PE (Everett 03)

**I-5 Everett, MP 197.35, MVFS**

- Five events collected at site PE (Everett 04)
- Four events collected 6.6 feet from PE (Everett 05)
- One events collected 13.1 feet from PE (Everett 06)

**I-5 Pilchuck, MP 210.71, VFS**

- Eleven events collected at site PE (Pilchuck 01)
- Four events collected 6.6 feet from PE (Pilchuck 02)
- Ten events collected 13.1 feet from PE (Pilchuck 03)

**I-5 Pilchuck, MP 210.78, CAVFS**

- One event collected 6.6 feet from PE (Pilchuck 04)
- Seven events collected 13.1 feet from PE (Pilchuck 05)

**I-5 Pilchuck, MP 210.85, MVFS**

- Six events collected at site PE (Pilchuck 06)
- Five events collected 6.6 feet from PE (Pilchuck 07)
- Five events collected 13.1 feet from PE (Pilchuck 08)

## **5.4 Monitoring Trends**

A primary goal of WSDOT's BMP effectiveness monitoring is to compare sample parameter and surface runoff values between influent and effluent points of each VFS BMP. TAPE currently requires a minimum of 12 paired influent and effluent samples for each parameter. A minimum two years of monitoring is generally recommended. WSDOT is currently analyzing samples for statistical relevance to TAPE goals.

## 5.5 Changes to the Monitoring Program

WSDOT staff evaluated the effectiveness of monitoring practices in WY12-WY15 and recorded their observations. These observations helped refine existing monitoring methods and procedures. These changes should improve the accuracy and efficiency of data collection, and make more effective use of limited staff time and resources.

The following changes were made in WY13 and WY14:

1. **Lack of monitoring staff time for maintenance:** In WY12 and WY13, the field team lacked sufficient staff to manage the significant site maintenance workload. Most personnel time was devoted to obtaining samples, with little time left for maintaining and improving the structural components of the sampling conveyance systems and equipment. Late in WY13, WSDOT hired a staff member whose primary duties are equipment and infrastructure repair and replacement, and site maintenance. This staff member is able to implement many infrastructure efficiencies in addition to maintaining system operations on a tighter schedule.
2. **Reduced WSDOT region staff support:** Staff support from region maintenance and environmental offices was critically important during the initial phase of monitoring. However, reductions in work force eventually limited region staff availability for stormwater monitoring. Shifting the majority of region staff responsibilities to stormwater monitoring staff at WSDOT headquarters helped focus sample collection efforts and ultimately improved consistency of work.
3. **Sample naming and labeling change:** The original naming and labeling conventions for laboratory samples were complex and non-intuitive, creating problems in often-chaotic field conditions. These sample names were replaced by a simple date-based naming convention that staff could easily generate and follow in the field. This change drastically reduced time in the field and improved sample labeling accuracy.
4. **The New forecasting tool:** In WY13, staff deployed a WSDOT Storm Event Reporting and Forecasting (SERF) web application tool. This tool summarizes NOAA regional forecast data and creates a communication email chain to alert staff when a qualifying storm approached. The SERF tool significantly shortens the time needed to generate a daily forecast, making faster and more efficient deployments for storm event sampling possible.
5. **New laboratory contract:** On June 1, 2014, the Washington State Department of Transportation established AmTest, Inc., in Kirkland, Washington as the primary analytical laboratory for the department's stormwater monitoring program. AmTest is an accredited analytical laboratory with the Washington State Department of Ecology, and has the ability to achieve acceptable limits of detection for the parameters measured as part of the VFS BMP monitoring project.

Establishing AmTest as WSDOT's primary analytical laboratory eliminated the need to communicate with multiple laboratories and streamlined the sample delivery process. Other benefits achieved under this contract include reduced costs for analytical services and availability of AmTest laboratory staff for off hours and weekend sample submittal.

The following changes were made in WY15:

1. **Ubicom® transceivers:** (Ubicom®) transceivers were installed at all monitoring sites. These transceivers allow two-way communication with the data loggers, allowing for programming changes to be made remotely. Typical changes include enabling sampling at a site and changing flow volume thresholds for flow-weighted aliquot collection. Utilization of Ubicom® has significantly reduced field mobilization time and increased sample collection success.
2. **Study completion:** Highway characterization work was completed in WY14 allowing staff to focus exclusively on collecting BMP effectiveness data. Also, TAPE guidelines and permit requirements stipulate a smaller number of constituents for BMP effectiveness sampling compared to highway characterization, so less water is required to complete all required analyses. This allows sampling of smaller volume storm events. Additionally, BMP effectiveness monitoring storm criteria more closely represent Pacific Northwest rainfall patterns, so more qualified storms are available for sampling.
3. **Study assessment:** WSDOT started a comparison and statistical assessment of influent and effluent samples at the BMP effectiveness monitoring sites. These analyses are ongoing and updated in response to incoming data.

Following guidelines in TAPE, these analyses include:

- Calculating aliquot-weighted flow rates at the pavement edge (influent) monitoring locations.
  - Calculating pollutant removal efficiencies at the two- and four-meter (effluent) monitoring locations.
  - Bootstrapping the collected mean pollutant removal efficiencies at the effluent locations.
  - Conducting Wilcoxon Rank Sign tests on influent to effluent pollutant mass.
4. **Hydrology validation:** WSDOT applied a more stringent hydrology validation process in WY15. After review of previously completed hydrology validation, it was found that some previously accepted data did not technically meet TAPE protocols.

## 5.6 Lessons Learned

WSDOT found that developing the VFS BMP effectiveness monitoring program was a complex endeavor. Following are some of the lessons learned from implementing the monitoring program:

1. **Establishment of guidance documents:** Guidance documents helped clarify the fundamentals of various monitoring activities allowing for efficient and consistent collection of the most reliable, representative data possible. Guidance documents detail all steps in the monitoring process from sample collection in the field to data management and validation in the office.
2. **Reassessment of staff roles:** With a limited number of field staff, the program was hard-pressed to fulfill the maintenance requirements of the sampling infrastructure. In response, staff that specialized in equipment and infrastructure maintenance and repair were hired. A more robust maintenance schedule was implemented that increased the reliability of the equipment and the accuracy of collected data.
3. **Changes to sampling deployment protocol:** Using a 50 percent likelihood of a qualifying amount of precipitation to trigger sampling deployment resulted in many unsuccessful deployments. To increase sampling success, the minimum likelihood was raised to 75 percent to reduce the chance that deployments would be made for non-qualifying rain events.
4. **Reassessment of the sampling infrastructure and maintenance:** WSDOT continually reassessed the efficacy of the monitoring infrastructure, making upgrades where appropriate. One such improvement was the replacement of the existing pressure transducers (PTs), which were subject to damage by freezing, with new ceramic PTs that could withstand freezing. This upgrade improved the continuity of stage measurements and reduced the expense of replacing PTs.

Additionally, the non-freezing PTs allowed for the phase out of compact bubble systems (CBSs) in subsequent projects. By phasing out the CBSs, WSDOT could deploy multiple PTs in stage measurement areas, allowing for comparisons between PTs which are much precise and reliable than CBS/PT comparisons.

5. **Cross-training of staff:** Cross-training staff proved to be an important factor for the program considering the limited number of staff. Having more field team members able to respond to different aspects of the program was a key part of the program's approach.
6. **Include data analysis throughout the study:** Including data analysis early in the study would have led to earlier improvements in methods and infrastructure. Problems receiving chemistry data in a timely manner contributed to this issue. An example of data analysis that led to programmatic changes was the conduction of a flow rate analysis that preceded

improvements in hydrology validation. Similarly, comparison of TSS concentrations between storm events instigated improvements to sample collection pipe clean out methods. The traditional pattern of first collecting field data and then conducting analysis may not be applicable to stormwater monitoring where collection methods themselves are novel and adaptive management informed by data analysis would aid earlier identification of instrumentation problems.

## 5.7 Projected Work and Future Monitoring Projects

WSDOT's VFS effectiveness monitoring continues with the goals of obtaining enough samples to satisfy permit requirements and produce useful data for decision-making. WSDOT will continue to analyze collected data to assess when statistical goals in TAPE have been met. Once these goals are met, WSDOT will produce a final BMP effectiveness report.

The 2014 NPDES municipal stormwater permit requires implementation of a monitoring program to evaluate the effectiveness of stormwater treatment and hydrologic management BMPs at WSDOT ferry terminals, rest areas, or maintenance facilities. To meet this requirement, the department will evaluate experimental, biofiltration swales (bioswales) at two maintenance facilities in western Washington, and one facility east of the Cascades.

These bioswales feature novel treatment designs, such as determining if treatment goals can be accomplished in shorter flow lengths or if oyster shell amendments reduce phosphorus discharges from compost-amendments. Research from the bioswales is expected to improve the department's ability and options for treating stormwater runoff. WSDOT is currently collecting hydrological and meteorological data at these bioswales, and will begin collecting water chemistry data in WY17.

In addition, the 2014 NPDES permit requires implementation of a new highway BMP effectiveness study. WSDOT is developing a new highway BMP study that will estimate saturated hydraulic conductivity ( $K_{sat}$ ) along compact highway embankments to inform a numerical model to be used to design stormwater sheet flow BMPs. This study received final approval from Ecology in April 2016. WSDOT staff are currently working to identify new study sites and develop the monitoring QAPP.

---

## Glossary

---

**analyte** – An element, ion, compound, or chemical moiety (pH, alkalinity) that is to be determined. The definition can be expanded to include organisms, such as fecal coliform (Kammin 2010).

**annual average daily traffic (AADT)** – The average, over a year, of the number of vehicles passing a point on a highway in both directions each day (Mohamad et al., 1998). Counts are estimated using Trip Generation, published by the Institute of Transportation Engineers, or using a traffic study prepared by a professional engineer or transportation specialist with expertise in traffic volume estimation (WSDOT 2014c).

**best management practices (BMPs)** – The structural devices, maintenance procedures, managerial practices, prohibitions of practices, and schedules of activities that are used singly or in combination to prevent or reduce the detrimental impacts of stormwater, such as pollution of water, degradation of channels, damage to structures, and flooding (WSDOT 2014c).

**data collection platform (DCP)** – A collection of instruments or sensors that operate and report to a central data logger. A DCP is collectively housed in a central location or “platform” at the monitoring site.

**Global Positioning System (GPS)** – A satellite navigation system used to determine ground position and velocity (location, speed, and direction).

**hydrograph** – A graph of flow versus time for a given point (Caltrans 2003).

**low-impact development (LID)** – An evolving approach to land development and stormwater management that uses a site’s natural features and specially designed BMPs to manage stormwater; it involves assessing and understanding the site, protecting native vegetation and soils, and minimizing and managing stormwater at the source. Low-impact development practices are appropriate for a variety of development types (WSDOT 2014c).

**National Pollutant Discharge and Elimination System (NPDES)** – The national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the state from point sources. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington State Department of Ecology (Ecology 2014).

**parameter** – A specified characteristic of a population or sample. Also, an analyte or grouping of analytes. Benzene, nitrate+nitrite, and anions are all parameters (Kammin 2010; Ecology 2004).

**pavement edge (PE) collector** – A 6-inch high-density polyethylene pipe or similar device that is installed to collect runoff from an impervious roadway. PE collectors also act as conveyance systems for stormwater from the road surface to pass through a flow measurement device and allow for composite sample collection.

**pH** – A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

**Quality Assurance Project Plan (QAPP)** – A document that describes the objectives of a monitoring project and the procedures necessary to ensure the quality and integrity of the collected data (Ecology 2004).

**representativeness** – The state or quality of being accurately representative of something. Expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at the sampling point, or an environmental condition (USEPA 2006).

**stormwater** – That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a stormwater drainage system into a defined surface water body or a constructed infiltration facility (WSDOT 2014c).

**stilling well** – A well or chamber that is connected to the main flow channel by a small inlet.

**time of concentration** – The time necessary for surface runoff to reach the edge of pavement collector from the hydraulically most remote point of the drainage area (WSDOT 2014c). Time of concentration provides a measure to ensure time pacing of the monitoring equipment is set to obtain a representative sample and to evaluate whether contributions from the entire basin are represented.

---

## Literature Cited

---

Caltrans. 2003. Caltrans Guidance Manual: Stormwater Monitoring Protocols, Third Edition. California Department of Transportation, Sacramento, CA. CTSW-RT-03-109.51.42.

Ebihara, T., C. Bryan Young, V. Tiwari, and L. Agee. 2009. Treatment of contaminated roadway runoff using vegetated filter strips. Department of Civil, Environmental, and Architectural Engineering, University of Kansas, Lawrence, Kansas.

Ecology. 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Washington State Department of Ecology, Olympia, WA. Publication No. 04-03-030.

🔗 <http://www.ecy.wa.gov/biblio/0403030.html>

\_\_\_\_\_. 2009a. Washington State Department of Transportation National Pollutant Discharge and Elimination System and State Waste Discharge Permit for Municipal Stormwater.

Washington State Department of Ecology, Olympia, WA. Permit No. WAR043000A. Issued February 4, 2009. Major Modifications May 5, 2010, and March 7, 2012.

\_\_\_\_\_. 2011. Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol – Ecology (TAPE), 2011 revision. Washington State Department of Ecology, Olympia, WA. Publication No. 11-10-061.

🔗 <http://www.ecy.wa.gov/biblio/1110061.html>

\_\_\_\_\_. 2014. Washington State Department of Transportation National Pollutant Discharge and Elimination System and State Waste Discharge Municipal Stormwater General Permit.

Washington State Department of Ecology, Olympia, WA. Permit No. WAR043000A. Issued March 6, 2014. 🔗 <http://www.ecy.wa.gov/programs/wq/stormwater/municipal/wsdot.html>

Kaighn, R. and S. Yu. 1996. Testing of roadside vegetation for highway runoff pollutant removal. Journal of the Transportation Research Board. 1523: 116-123.

Kammin, W. 2010. Ecology Quality Assurance Glossary. Washington State Department of Ecology, Olympia, WA.

Mohamad, D., K. C. Sinha, and T. Kuczek. 1998. An annual average daily traffic prediction model for county roads. Transportation Research Record 1617, Paper No. 98-1115. Presented at the Transportation Research Board, 77th Annual Meeting, January 11-15, 1998, Washington D. C.

🔗 <http://trb.metapress.com/content/22j1822x818533mx/fulltext.pdf>

NWS. 2010. National Weather Service Instruction. U. S. Department of Commerce, National Oceanic and Atmospheric Association, National Weather Service, Silver Spring, MD. NWSPD 10-13.

🔗 <http://www.weather.gov/om/coop/standard.htm>

USEPA. 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4. EPA/240/B-06/001. February 2006.

WSDOT. 2011a. Quality Assurance Project Plan for WSDOT Roadway Stormwater Treatment Evaluation: Best Management Practices. Washington State Department of Transportation, Environmental Services Office, Olympia, WA. Revised March 2014, and updated October 2015.

\_\_\_\_\_. 2011b. GIS Workbench. Washington State Department of Transportation, Environmental Services Office, Olympia, WA.

\_\_\_\_\_. 2011c. Standard Operating Procedure for Equipment Maintenance and Cleaning. Washington State Department of Transportation, Olympia, WA.

\_\_\_\_\_. 2013. WSDOT NPDES Municipal Stormwater Permit Highway Runoff and BMP Effectiveness Stormwater Monitoring Report (S7.B, S7.C, and S7.E) Water Year 2012. Washington State Department of Transportation, Olympia, WA.

\_\_\_\_\_. 2014a. WSDOT NPDES Municipal Stormwater Permit BMP Effectiveness Monitoring Report (S7.C and S7.D). Washington State Department of Transportation, Environmental Services Office, Olympia, WA. October 2014.

\_\_\_\_\_. 2014b. Work Zone Traffic Control Guidelines. Publication No. M 54-44.04. Washington State Department of Transportation, Olympia, WA.

🔗 [www.wsdot.wa.gov/publications/manuals/fulltext/m54-44/workzone.pdf](http://www.wsdot.wa.gov/publications/manuals/fulltext/m54-44/workzone.pdf)

\_\_\_\_\_. 2014c. Highway Runoff Manual (Supp. 2016). Washington State Department of Transportation, Environmental and Engineering Programs Design Office, Olympia, WA. Publication M 31-16.04.

🔗 [www.wsdot.wa.gov/environment/waterquality/runoff/highwayrunoffmanual.htm01](http://www.wsdot.wa.gov/environment/waterquality/runoff/highwayrunoffmanual.htm01)

\_\_\_\_\_. 2014d. Annual Traffic Report. Washington State Department of Transportation, Olympia, WA. 🔗 [www.wsdot.wa.gov/mapsdata/travel/annualtrafficreport.htm](http://www.wsdot.wa.gov/mapsdata/travel/annualtrafficreport.htm)

\_\_\_\_\_. 2015. WSDOT NPDES BMP Effectiveness Monitoring Status Report (S7.C and S7.D) Water Years 2012-14. Washington State Department of Transportation, Olympia, WA.

\_\_\_\_\_. 2016. Safety Procedures and Guidelines Manual. Publication No. M 75-01.25. Washington State Department of Transportation, Olympia, WA. Available at:

🔗 [www.wsdot.wa.gov/publications/manuals/m75-01.htm](http://www.wsdot.wa.gov/publications/manuals/m75-01.htm)

---

## Acronyms, Abbreviations, and Units of Measurement

---

### Acronyms and Abbreviations

AADT	annual average daily traffic
BMP	best management practice
CAVFS	compost-amended vegetated filter strip
CBS	compact bubble sensor
Cu	copper
DCP	data collection platform
Ecology	Washington State Department of Ecology
ESO	Environmental Services Office
GIS	geographical information system
GPS	Global Positioning System
HDPE	high-density polyethylene
HQ	WSDOT Headquarters
I-5	Interstate 5
LID	low-impact development
NPDES	National Pollutant Discharge Elimination System
NOAA	National Oceanic and Atmospheric Association
NWS	National Weather Service
PE	pavement edge
pH	measure of alkalinity or acidity
PSD	particle size distribution
PT	pressure transducer
QAPP	Quality Assurance Project Plan
QC	quality control
SERF	Storm Event Reporting and Forecasting tool
TAPE	Technology Assessment Protocol – Ecology (TAPE)
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
VFS	vegetated filter strip
WSDOT	Washington State Department of Transportation
WY	water year
Zn	zinc

## Units of Measurement

ft	feet
mg	milligrams
mg/L	milligrams per liter (parts per million)
mL	milliliters

---

## **Appendix A: Analytical Data**

---

This page intentionally left blank

Everett VFS	Storm Event						
PARAMETER	UNITS	11/6/2012		3/2/2013		3/19/2013	
Conventionals							
TSS	mg/L	29	*J	132		--	
Hardness as CaCO <sub>3</sub>	mg/L	11.5	*J	--		16.5	
Nutrients							
Total Phosphorous	mg/L	0.0423	*J	--		0.121	
Orthophosphate	mg/L	0.01	U	--		--	
Total Kjeldahl Nitrogen	mg/L	0.91	U	--		0.85	J
Nitrate-Nitrite	mg/L	0.335	*J	--		0.224	
Metals							
Total Recoverable Copper	ug/L	21.7	*J	--		--	
Dissolved Copper	ug/L	6.05	J	--		--	
Total Recoverable Zinc	ug/L	64.5	*J	--		--	
Dissolved Zinc	ug/L	27.7	J	--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.11	*J	--		9.82	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	17.11	*J	--		10.76	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.22	*J	--		8.25	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		0.01	U
Particle/Grain Size, PhiScale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	4.94	*J	--		57.94	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	8.27	*J	--		12.3	

Notes:

-- Parameter not analyzed

U - Analyte not detected above reported result

J - Estimated value

UJ - Analyte not detected above reported result, reported reporting limit may inaccurate

\*J - Hydrology data is an estimate

\*R - Samples were rejected after hydrology review

Everett VFS (cont.)		Storm Event						
PARAMETER		UNITS	5/21/2013		1/7/2014		1/28/2014	
Conventionals								
TSS	mg/L	67		97		92		
Hardness as CaCO <sub>3</sub>	mg/L	18.3		43.3		--		
Nutrients								
Total Phosphorous	mg/L	0.157		0.149		0.113		
Orthophosphate	mg/L	0.0189		0.0102		0.0114	J	
Total Kjeldahl Nitrogen	mg/L	1.2	J	1.6		1.2		
Nitrate-Nitrite	mg/L	0.74		0.328		0.202		
Metals								
Total Recoverable Copper	ug/L	40.1		51.4		38.6		
Dissolved Copper	ug/L	12.5		12.5		12.7	J	
Total Recoverable Zinc	ug/L	131		215		177		
Dissolved Zinc	ug/L	40.5		65.1		62.9	J	
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	15.96		2.84		--		
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	29.86		11.99		--		
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	13.62		2.73		--		
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	--		
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	--		
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	8.11		70.65		--		
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	24.89		15.62		--		

Everett VFS (cont.)		Storm Event						
PARAMETER		UNITS	3/19/2014		4/21/2014		6/13/2014	
Conventionals								
TSS	mg/L	65		23		38		
Hardness as CaCO <sub>3</sub>	mg/L	33.1		13.9		19		
Nutrients								
Total Phosphorous	mg/L	0.112		0.0689		0.098		
Orthophosphate	mg/L	--		0.0202		--		
Total Kjeldahl Nitrogen	mg/L	1.6		1.4		2.71		
Nitrate-Nitrite	mg/L	0.708		0.559		0.51		
Metals								
Total Recoverable Copper	ug/L	--		30.1		--		
Dissolved Copper	ug/L	--		16.1		--		
Total Recoverable Zinc	ug/L	--		72		--		
Dissolved Zinc	ug/L	--		28.1		--		
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.83		2.31		7.55		
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	8.41		4.2		24.45		
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	1.03		0.1		2.31		
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.12		0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	52.19		17.55		0.01	U	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	6.54		2.09		12.54		

Everett VFS (cont.)	Storm Event						
PARAMETER	UNITS	10/14/2014		12/19/2014		3/14/2015	
Conventionals							
TSS	mg/L	25	*J	71	*J	260	
Hardness as CaCO <sub>3</sub>	mg/L	9.8	*J	24	*J	23	
Nutrients							
Total Phosphorous	mg/L	0.089	*J	0.071	*J	0.201	
Orthophosphate	mg/L	0.075	*J	0.005	U	0.023	J
Total Kjeldahl Nitrogen	mg/L	1.25	*J	2.29	*J	0.805	
Nitrate-Nitrite	mg/L	0.83	J	0.26	J	0.95	J
Metals							
Total Recoverable Copper	ug/L	22.4	*J	37.1	*J	62.3	
Dissolved Copper	ug/L	8.29	H	6.78	H	10.1	R
Total Recoverable Zinc	ug/L	59.4	*J	139	*J	173	
Dissolved Zinc	ug/L	43.1	HJ	40.9	H	29.8	R
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	2.59	*J	--		35.41	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	23.24	*J	--		12.68	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	17.87	*J	--		16.59	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		9.56	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	--		224.45	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	3.02	*J	--		13.04	

Everett VFS (cont.)		Storm Event						
PARAMETER		UNITS	4/11/2015		6/3/2015		8/29/2015	
Conventionals								
TSS	mg/L	54	*J	29		120		
Hardness as CaCO <sub>3</sub>	mg/L	24	*J	26		35		
Nutrients								
Total Phosphorous	mg/L	0.124	*J	0.202		0.494		
Orthophosphate	mg/L	0.086	*J	0.014		0.093		
Total Kjeldahl Nitrogen	mg/L	0.1	U	4.5		1.79		
Nitrate-Nitrite	mg/L	0.57	J	1.1	J	0.79		
Metals								
Total Recoverable Copper	ug/L	26.2	*J	34.6		58.8		
Dissolved Copper	ug/L	18.8	H	20.4	H	22.5		
Total Recoverable Zinc	ug/L	61.2	*J	88.8		193		
Dissolved Zinc	ug/L	47	H	42.5	H	39.4		
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	18.2	J	3.1		79.4		
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	2.2	J	1.7		9.1		
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.3	*J	1.9		0.4		
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	2		26.9		
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	24.5	J	28.4		63		
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.1	*J	1.4		3.3		

Everett VFS 2m	Storm Report						
PARAMETER	UNITS	3/2/2013		3/19/2013		5/21/2013	
Conventionals							
TSS	mg/L	66	*J	--		31	*R
Hardness as CaCO <sub>3</sub>	mg/L	17.4	*J	10.9	*R	25.3	*R
Nutrients							
Total Phosphorous	mg/L	0.112	*J	0.0971	*R	0.309	*R
Orthophosphate	mg/L	--	*J	--		0.146	*R
Total Kjeldahl Nitrogen	mg/L	0.9	J	--		2.4	J
Nitrate-Nitrite	mg/L	0.277	*J	0.12	*R	0.901	*R
Metals							
Total Recoverable Copper	ug/L	--		--		28.1	*R
Dissolved Copper	ug/L	--		--		14.8	*R
Total Recoverable Zinc	ug/L	--		--		76	*R
Dissolved Zinc	ug/L	--		--		32.8	*R
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.67	*J	19.91	*R	9.72	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	16.05	*J	8.89	*R	24.85	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.01	U	8.61	*R	8.63	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	30.36	*J	36.37	*R	0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	20.18	*J	11.74	*R	10.25	*R

Everett VFS 2m (cont.)		Storm Report					
PARAMETER	UNITS	1/7/2014		1/28/2014		3/19/2014	
<b>Conventionals</b>							
TSS	mg/L	31	*J	20	*R	34	*R
Hardness as CaCO <sub>3</sub>	mg/L	28.3	*J	38.1	*R	--	*R
<b>Nutrients</b>							
Total Phosphorous	mg/L	0.135	*J	0.115	*R	0.0914	*R
Orthophosphate	mg/L	0.0371	*J	--		--	
Total Kjeldahl Nitrogen	mg/L	1.6	*J	1.4	*R	0.68	J
Nitrate-Nitrite	mg/L	0.401	*J	0.097	*R	0.353	*R
<b>Metals</b>							
Total Recoverable Copper	ug/L	22.7	*J	--		--	
Dissolved Copper	ug/L	12.3	*J	--		--	
Total Recoverable Zinc	ug/L	94.8	*J	--		--	
Dissolved Zinc	ug/L	40.3	*J	--		--	
<b>Particle Size Distribution</b>							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.55	*J	3.14	*R	0.55	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	3.59	*J	3.01	*R	4.54	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.44	*J	1.40	*R	0.66	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.04	*R	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	19.55	*J	30.24	*R	25.10	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	5.32	*J	2.76	*R	5.03	*R

Everett VFS 2m (cont.)		Storm Report					
PARAMETER	UNITS	4/21/2014		6/13/2014		10/14/2014	
<b>Conventionals</b>							
TSS	mg/L	9	*R	14		5	*R
Hardness as CaCO <sub>3</sub>	mg/L	25.2	*R	34		5.1	*R
<b>Nutrients</b>							
Total Phosphorous	mg/L	0.259	*R	0.424		0.057	*R
Orthophosphate	mg/L	0.196	*R	--		0.034	*R
Total Kjeldahl Nitrogen	mg/L	2	*R	5.39		1.04	*R
Nitrate-Nitrite	mg/L	2.01	*R	1	J	0.26	J
<b>Metals</b>							
Total Recoverable Copper	ug/L	20.7	*R	--		9.25	*R
Dissolved Copper	ug/L	16.1	J	--		4.07	H
Total Recoverable Zinc	ug/L	82.1	*R	--		25.9	*R
Dissolved Zinc	ug/L	72.7	J	--		19	HJ
<b>Particle Size Distribution</b>							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.11	*R	0.62		0.1	U
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.89	*R	1.2		8.44	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.22	*R	0.21		0.22	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.1	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.1	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	6.43	*R	13.36		0.1	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.45	*R	3.66		1.16	*R

Everett VFS 2m (cont.)	Storm Event								
PARAMETER	UNITS	12/19/2014		3/14/2015		6/3/2015		8/29/2015	
Conventionals									
TSS	mg/L	20	*R	120	*R	8	*R	11	*R
Hardness as CaCO <sub>3</sub>	mg/L	15	*R	15	*R	67	*R	33	*R
Nutrients									
Total Phosphorous	mg/L	0.125	*R	0.197	*R	0.776	J	0.507	*R
Orthophosphate	mg/L	0.096	*R	0.048	J	0.335	*R	0.352	*R
Total Kjeldahl Nitrogen	mg/L	2.78	*R	0.836	*R	5.45	*R	1.58	*R
Nitrate-Nitrite	mg/L	0.85	*R	0.81	J	3.7	J	2.9	*R
Metals									
Total Recoverable Copper	ug/L	17.3	*R	35.2	*R	49.8	*R	32.9	*R
Dissolved Copper	ug/L	7.67	H	9.86	R	43.7	H	31.4	*R
Total Recoverable Zinc	ug/L	61.8	*R	134	*R	180	*R	87.4	*R
Dissolved Zinc	ug/L	40.1	H	29.6	R	144	H	87.9	*R
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		7.11	*R	0.5	*R	0.7	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		5.82	*R	0.8	*R	2	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		2.52	*R	0.9	*R	1.3	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.01	U	0.01	U	0.1	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		0.01	*R	0.3	*R	0.1	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		92.5	*R	16.7	*R	12	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		5.82	*R	0.4	*R	0.6	*R

Everett VFS 4m		Storm Event						
PARAMETER		UNITS	11/6/2012		12/11/2012		3/2/2013	
Conventionals								
TSS	mg/L	49	*R	10		11		
Hardness as CaCO <sub>3</sub>	mg/L	39.6	*R	26.5		24.9		
Nutrients								
Total Phosphorous	mg/L	2.1	*R	0.189		0.197		
Orthophosphate	mg/L	1.69	*R	0.107		--		
Total Kjeldahl Nitrogen	mg/L	1.9	*R	1.2	J	1.4		
Nitrate-Nitrite	mg/L	--		0.472		0.472		
Metals								
Total Recoverable Copper	ug/L	12	*R	6.8		--		
Dissolved Copper	ug/L	9.86	J	4.85		--		
Total Recoverable Zinc	ug/L	155	*R	40.1		--		
Dissolved Zinc	ug/L	145	J	38.3		--		
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	6.88	*R	1.89		10.75		
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	3.65	*R	0.6		3.89		
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.78	*R	1.22		0.13		
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	1.82	*R	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	23.49	*R	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	28.74	*R	9.47		0.01	U	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.29	*R	1.28		2.18		

Everett VFS 4m (cont.)		Storm Event						
PARAMETER		UNITS	3/19/2013		1/7/2014		1/28/2014	
Conventionals								
TSS	mg/L	--		16		12		
Hardness as CaCO <sub>3</sub>	mg/L	22.5	*R	25.8		32.5		
Nutrients								
Total Phosphorous	mg/L	0.253	*R	0.213		0.269		
Orthophosphate	mg/L	--		0.105		--		
Total Kjeldahl Nitrogen	mg/L	0.86	J	2.3		3.2		
Nitrate-Nitrite	mg/L	0.395	*R	0.476		0.477		
Metals								
Total Recoverable Copper	ug/L	--		11.7		--		
Dissolved Copper	ug/L	--		7.87		--		
Total Recoverable Zinc	ug/L	--		53.1		--		
Dissolved Zinc	ug/L	--		37.8		--		
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	8.83	*R	1.83		4.02		
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	9.09	*R	1.84		0.82		
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	5.38	*R	0.75		9.86		
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.03		
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	16.15		10.54		
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	5.16	*R	1.44		0.56		

Everett VFS 4m (cont.)		Storm Event							
PARAMETER	UNITS	3/15/2014		3/19/2014		4/21/2014		6/13/2014	
<b>Conventionals</b>									
TSS	mg/L	22		41	*R	28	*R	22	*J
Hardness as CaCO <sub>3</sub>	mg/L	10.2		15.2	*R	24.9	*R	33	*J
<b>Nutrients</b>									
Total Phosphorous	mg/L	0.114		0.228	*R	1.65	*R	0.896	J
Orthophosphate	mg/L	0.0502		--		1.16	*R	--	
Total Kjeldahl Nitrogen	mg/L	1.3		1.3	*R	8	*R	7.84	J
Nitrate-Nitrite	mg/L	0.155		0.403	*R	0.793	*R	0.015	*J
<b>Metals</b>									
Total Recoverable Copper	ug/L	6.27		--		37.7	*R	--	
Dissolved Copper	ug/L	3.33		--		23.3	*R	--	
Total Recoverable Zinc	ug/L	22.1	J	--		50.5	*R	--	
Dissolved Zinc	ug/L	13.3		--		24.8	*R	--	
<b>Particle Size Distribution</b>									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	9.03		6.01	*R	9.77	*R	4.39	*J
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	1.28		3.52	*R	3.62	*R	0.82	*J
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.2		3.16	*R	9.55	*R	1.25	*J
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	1.21		0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	16.1		35.67	*R	17.50	*R	24.39	*J
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.87		2.94	*R	1.49	*R	1.42	*J

Everett VFS 4m (cont.)		Storm Event						
PARAMETER		UNITS	10/14/2014		12/19/2014		3/14/2015	
Conventionals								
TSS	mg/L	39	*R	31		110		
Hardness as CaCO <sub>3</sub>	mg/L	8.5	*R	20		33		
Nutrients								
Total Phosphorous	mg/L	0.17	*R	0.557		3.65	J	
Orthophosphate	mg/L	0.073	*R	0.297		0.266	J	
Total Kjeldahl Nitrogen	mg/L	1.78	*R	3.79		2.34		
Nitrate-Nitrite	mg/L	0.96	J	0.33		2.3	J	
Metals								
Total Recoverable Copper	ug/L	12	*R	15.1		29.2		
Dissolved Copper	ug/L	4.74	H	9.2	H	14.9	R	
Total Recoverable Zinc	ug/L	37.5	*R	49.2		91.5		
Dissolved Zinc	ug/L	18.4	HJ	31.7	H	39.7	R	
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	20.4	*R			11.14		
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	33.28	*R			2.97		
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	8.08	*R			29.56		
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U			0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U			0.06		
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U			47.51		
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	4.75	*R			1.8		

Everett VFS 4m (cont.)		Storm Event						
PARAMETER		UNITS	4/11/2015		6/3/2015			
Conventionals								
TSS	mg/L	20		6	*J			
Hardness as CaCO <sub>3</sub>	mg/L	27		73	*J			
Nutrients								
Total Phosphorous	mg/L	1.02		1.97	J			
Orthophosphate	mg/L	0.612		1.27	*J			
Total Kjeldahl Nitrogen	mg/L	2.18		8.62	*J			
Nitrate-Nitrite	mg/L	1.5		1.2	J			
Metals								
Total Recoverable Copper	ug/L	23.6		48.5	*J			
Dissolved Copper	ug/L	15.9		39.6	H			
Total Recoverable Zinc	ug/L	127		118	*J			
Dissolved Zinc	ug/L	92.8		93.7	H			
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	2.4		0.2	J			
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	22		0.3	J			
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.8		0.01	UJ			
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U			
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.1	J			
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	6.2	J			
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	6.2		0.1	J			

Everett MVFS		Storm Report						
PARAMETER		UNITS	11/6/2012		3/2/2013		3/19/2013	
Conventionals								
TSS	mg/L	51	J	100	*R	88		
Hardness as CaCO <sub>3</sub>	mg/L	13.5		17.3	*R	14.1		
Nutrients								
Total Phosphorous	mg/L	0.0817		0.107	*R	0.13		
Orthophosphate	mg/L	0.01	U	--		--		
Total Kjeldahl Nitrogen	mg/L	1.1		1.1	*R	--		
Nitrate-Nitrite	mg/L	0.373		0.246	*R	0.198		
Metals								
Total Recoverable Copper	ug/L	19.6		--		--		
Dissolved Copper	ug/L	5.93	J	--		--		
Total Recoverable Zinc	ug/L	109		--		--		
Dissolved Zinc	ug/L	73.5	J	--		--		
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.96		--		--		
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	4		--		--		
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.82		--		--		
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		--		
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		--		
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	30.07		--		--		
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	4.78		--		--		

Everett MVFS (cont.)		Storm Event						
PARAMETER		UNITS	4/12/2013		5/21/2013		1/7/2014	
Conventionals								
TSS	mg/L	72			55		89	
Hardness as CaCO <sub>3</sub>	mg/L	17.6			16.8		39.5	
Nutrients								
Total Phosphorous	mg/L	0.138	J		0.142		0.129	
Orthophosphate	mg/L	--			0.0183		0.01	U
Total Kjeldahl Nitrogen	mg/L	0.46	J		1.5	J	1.4	
Nitrate-Nitrite	mg/L	0.455			0.676		0.39	
Metals								
Total Recoverable Copper	ug/L	--			34.6		47.4	
Dissolved Copper	ug/L	--			13.8		13	
Total Recoverable Zinc	ug/L	--			157		224	
Dissolved Zinc	ug/L	--			74.2		83.3	
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	9.04			12.76		1.57	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	17.83			32.66		11.86	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	8.74			10.98		1.46	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	18.71			0.01	U	64.73	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	22.11			21.86		15.36	

Everett MVFS (cont.)	Storm Event								
PARAMETER	UNITS	1/28/2014		4/8/2014		4/21/2014		6/12/2014	
Conventionals									
TSS	mg/L	70		55		36		38	J
Hardness as CaCO <sub>3</sub>	mg/L	50.2		20.8		12.4		15	
Nutrients									
Total Phosphorous	mg/L	0.0932		0.237		0.0671		0.114	
Orthophosphate	mg/L	0.01	UJ	0.018		0.01	U	--	
Total Kjeldahl Nitrogen	mg/L	1.5		--		1.3		2.95	
Nitrate-Nitrite	mg/L	0.202		--		0.572		0.33	
Metals									
Total Recoverable Copper	ug/L	31.6		61		21.8		--	
Dissolved Copper	ug/L	11	J	37.5		8.19		--	
Total Recoverable Zinc	ug/L	184		191		121		--	
Dissolved Zinc	ug/L	85.6	J	91.4		64.5		--	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	3.57		1.66		4.1		3.74	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	6.67		8.1		5.2		21.63	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	3.13		1.11		0.11		1.46	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.2		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	59.22		60.67		28.99		0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	8.64		3.38		2.38		18.28	

Everett MVFS (cont.)		Storm Event						
PARAMETER		UNITS	10/14/2014		10/28/2014		12/19/2014	
Conventionals								
TSS	mg/L	35		15	J	73	*R	
Hardness as CaCO <sub>3</sub>	mg/L	7.5		13		24	*R	
Nutrients								
Total Phosphorous	mg/L	0.059		0.088	J	0.076	*R	
Orthophosphate	mg/L	0.03		0.06		0.038	*R	
Total Kjeldahl Nitrogen	mg/L	1.73		3.96		2.57	*R	
Nitrate-Nitrite	mg/L	0.49		8.9		0.21	*R	
Metals								
Total Recoverable Copper	ug/L	25.9		36.2		38.9	*R	
Dissolved Copper	ug/L	11.8	H	14	H	12.3	H	
Total Recoverable Zinc	ug/L	82.7		115		162	*R	
Dissolved Zinc	ug/L	71.4	HJ	81.4	H	65.1	H	
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.43		8.52		--		
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	20.76		28.9		--		
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	7.51		1.83		--		
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	--		
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	--		
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	0.01	U	--		
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	6.48		11.74		--		

Everett MVFS (cont.)		Storm Event						
PARAMETER		UNITS	3/14/2015		3/31/2015		8/29/2015	
Conventionals								
TSS	mg/L	200	*J	37		55	J	
Hardness as CaCO <sub>3</sub>	mg/L	20	J	19		34	J	
Nutrients								
Total Phosphorous	mg/L	0.13	*J	0.145		0.236	J	
Orthophosphate	mg/L	0.005	UJ	0.017		0.02	J	
Total Kjeldahl Nitrogen	mg/L	0.761	*J	0.633		1.45	J	
Nitrate-Nitrite	mg/L	0.96	J	0.63	J	0.92	J	
Metals								
Total Recoverable Copper	ug/L	44.3	*J	35.4		41.4	J	
Dissolved Copper	ug/L	10.5	R	13.7	H	26.8	R	
Total Recoverable Zinc	ug/L	192	*J	157		190	J	
Dissolved Zinc	ug/L	56.7	R	73.1	H	105	R	
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	25.13	*J	0.81		15.4	J	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	9.62	*J	3.47		3	J	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	3.47	*J	0.01	UJ	5.5	J	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	1.4	*J	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	142.64	*J	31		31	J	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	9.1	*J	1.1		1.1	J	

Everett MVFS 2m	Storm Event						
PARAMETER	UNITS	11/6/2012		3/2/2013		4/12/2013	
Conventionals							
TSS	mg/L	51	*R	8	*R	33	*R
Hardness as CaCO <sub>3</sub>	mg/L	41.8	*R	24	*R	34.9	*R
Nutrients							
Total Phosphorous	mg/L	0.464	*R	0.512	*R	2.13	J
Orthophosphate	mg/L	0.181	*R	--		--	
Total Kjeldahl Nitrogen	mg/L	--		2.3	*R	10	*R
Nitrate-Nitrite	mg/L	--		0.725	*R	0.109	*R
Metals							
Total Recoverable Copper	ug/L	13.5	*R	--		--	
Dissolved Copper	ug/L	10.5	J	--		--	
Total Recoverable Zinc	ug/L	55.7	*R	--		--	
Dissolved Zinc	ug/L	49.1	J	--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		1.34	*R	0.6	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		0.46	*R	3.49	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		0.01	U	1.11	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		4.23	*R	2.66	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		0.67	*R	11.14	*R

Everett MVFS 2m (cont.)		Storm Event					
PARAMETER	UNITS	5/21/2013		1/7/2014		1/28/2014	
<b>Conventionals</b>							
TSS	mg/L	19	*R	27	*J	34	*J
Hardness as CaCO <sub>3</sub>	mg/L	75.3	*R	22.6	*J	26.7	*J
<b>Nutrients</b>							
Total Phosphorous	mg/L	9.01	*R	1.13	*J	2.24	*J
Orthophosphate	mg/L	8.91	*R	0.827	*J	--	*J
Total Kjeldahl Nitrogen	mg/L	20	J	5.8	*J	9.9	*J
Nitrate-Nitrite	mg/L	1.11	*R	0.773	*J	1.66	*J
<b>Metals</b>							
Total Recoverable Copper	ug/L	32.6	*R	13.7	*J	--	*J
Dissolved Copper	ug/L	25	*R	8.62	*J	--	*J
Total Recoverable Zinc	ug/L	129	*R	83.0	*J	--	*J
Dissolved Zinc	ug/L	82.6	*R	44.6	*J	--	*J
<b>Particle Size Distribution</b>							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	3.47	*R	5.70	*J	5.20	*J
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.88	*R	0.69	*J	1.59	*J
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.66	*R	2.65	*J	5.87	*J
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.4	*R	0.01	U	0.17	*J
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	14.16	*R	0.61	*J	22.91	*J
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	5.76	*R	8.71	*J	16.45	*J
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.22	*R	0.49	*J	0.53	*J

Everett MVFS 2m (cont.)		Storm Event						
PARAMETER		UNITS	4/8/2014		4/21/2014		6/12/2014	
Conventionals								
TSS	mg/L	24	*R	49	*J	30	*J	
Hardness as CaCO <sub>3</sub>	mg/L	34.1	*R	32.1	*J	62	*J	
Nutrients								
Total Phosphorous	mg/L	4.87	*R	3.46	*J	5.61	J	
Orthophosphate	mg/L	4.43	*R	3.09	*J	0.01	*J	
Total Kjeldahl Nitrogen	mg/L	21	*R	14	*J	17.5	J	
Nitrate-Nitrite	mg/L	0.736	*R	0.978	*J	2.9	J	
Metals								
Total Recoverable Copper	ug/L	19.4	*R	28	*J	--		
Dissolved Copper	ug/L	14.4	J	14.9	J	--		
Total Recoverable Zinc	ug/L	69.2	*R	104	*J	--		
Dissolved Zinc	ug/L	34.2	*R	26.3	J	--		
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.35	*R	10.45	*J	0.01	U	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	2.68	*R	2.87	*J	0.83	*J	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.90	*R	7.07	*J	0.21	*J	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	2.02	*R	2.52	*J	0.04	*J	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	37.24	*R	57.13	*J	17.03	*J	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.47	*R	3.08	*J	1.95	*J	

Everett MVFS 2m (cont.)	Storm Event								
PARAMETER	UNITS	10/14/2014		12/19/2014		3/14/2015		8/29/2015	
Conventionals									
TSS	mg/L	32	*R	26	*R	150	*R	57	*R
Hardness as CaCO <sub>3</sub>	mg/L	31	*R	25	*R	37	*R	58	*R
Nutrients									
Total Phosphorous	mg/L	2.18	J	2.43	*R	3.02	J	2.58	*R
Orthophosphate	mg/L	1.51	*R	1.37	*R	1.91	J	0.791	*R
Total Kjeldahl Nitrogen	mg/L	6.83	J	8.78	*R	5.41	*R	4.67	*R
Nitrate-Nitrite	mg/L	3.6	*R	1.6	*R	5.5	J	2.7	*R
Metals									
Total Recoverable Copper	ug/L	28.2	*R	15.8	*R	32.9	*R	35.3	*R
Dissolved Copper	ug/L	9.2	H	9.61	*R	16.5	R	32.9	*R
Total Recoverable Zinc	ug/L	83.4	*R	67	*R	135	*R	103	*R
Dissolved Zinc	ug/L	52.4	HJ	38.7	*R	53.8	R	88.4	*R
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	18.62	*R	--		14.25	*R	16.4	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	17.63	*R	--		12.36	*R	1.7	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	3.39	*R	--		11.99	*R	1.6	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		8.19	*R	5.2	*R
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		337.12	*R	24.2	*R
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	--		349.34	*R	14	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	4.13	*R	--		11.79	*R	0.5	*R

Everett MVFS 4m		Storm Event					
PARAMETER	UNITS	12/11/2012		3/2/2013		3/19/2013	
Conventionals							
TSS	mg/L	26		10	*R	8	*R
Hardness as CaCO <sub>3</sub>	mg/L	22.1		21.1	*R	22.3	*R
Nutrients							
Total Phosphorous	mg/L	0.8		0.469	*R	0.548	*R
Orthophosphate	mg/L	0.485		--		--	
Total Kjeldahl Nitrogen	mg/L	--		1.9	*R	2.4	*R
Nitrate-Nitrite	mg/L	0.461		0.943	*R	0.581	*R
Metals							
Total Recoverable Copper	ug/L	7.39		--		--	
Dissolved Copper	ug/L	3.6		--		--	
Total Recoverable Zinc	ug/L	34.2		--		--	
Dissolved Zinc	ug/L	13.6		--		--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		0.01	U	5.66	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		3.75	*R	0.41	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		0.01	U	1.52	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		0.01	U	5.06	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		2.28	*R	0.84	*R

Everett MVFS 4m (cont.)	Storm Event						
PARAMETER	UNITS	1/28/2014		6/12/2014		10/14/2014	
Conventionals							
TSS	mg/L	--		--		21	*R
Hardness as CaCO <sub>3</sub>	mg/L	--		--		27	*R
Nutrients							
Total Phosphorous	mg/L	--		--		3.26	J
Orthophosphate	mg/L	--		--		2.35	*R
Total Kjeldahl Nitrogen	mg/L	31	*R	31	*R	6.53	J
Nitrate-Nitrite	mg/L	--		--		1.4	*R
Metals							
Total Recoverable Copper	ug/L	--		--		15.1	*R
Dissolved Copper	ug/L	--		--		9.98	H
Total Recoverable Zinc	ug/L	--		--		51.7	*R
Dissolved Zinc	ug/L	--		--		52.2	HJ
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	7.76	*R	7.76	*R	2.61	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	2.32	*R	2.32	*R	17.42	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	8.79	*R	8.79	*R	1.96	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	1.39	*R	1.39	*R	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	34.09	*R	34.09	*R	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	37.23	*R	37.23	*R	0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.41	*R	1.41	*R	5.32	*R

Everett MVFS 4m (cont.)	Storm Event								
PARAMETER	UNITS	10/28/2014		12/19/2014		3/14/2015		8/29/2015	
Conventionals									
TSS	mg/L	4	J	110	*R	120	*R	39	*R
Hardness as CaCO <sub>3</sub>	mg/L	58		24	*R	45	*R	66	*R
Nutrients									
Total Phosphorous	mg/L	1.58	J	2.39	*R	2.22	J	4.51	*R
Orthophosphate	mg/L	1.06		1.25	*R	1.54	J	1.62	*R
Total Kjeldahl Nitrogen	mg/L	5.58		8.47	J	3.74	*R	4.11	*R
Nitrate-Nitrite	mg/L	3.4		1.5	J	8.8	J	3.6	*R
Metals									
Total Recoverable Copper	ug/L	6.48		20	*R	23.1	*R	37.1	*R
Dissolved Copper	ug/L	4.25	H	6.87	H	9.79	R	35.2	*R
Total Recoverable Zinc	ug/L	37.9		95.8	*R	101	*R	133	*R
Dissolved Zinc	ug/L	28.3	H	30.5	H	39.7	R	102	*R
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.61			*R	9.93	*R	7.7	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	3.79			*R	1.94	*R	0.01	U
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.65			*R	13.6	*R	1.3	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U		*R	0.01	U	27.8	*R
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U		*R	14.9	*R	7.1	*R
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U		*R	35.4	*R	4	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.19			*R	1.23	*R	0.1	*R

Pilchuck VFS		Storm Report							
PARAMETER	UNITS	10/18/2012		11/7/2012		2/21/2013		2/25/2013	
<b>Conventionals</b>									
TSS	mg/L	31		21	*J	--		32	*J
Hardness as CaCO <sub>3</sub>	mg/L	17		17.4	*J	--		46.5	*J
<b>Nutrients</b>									
Total Phosphorous	mg/L	0.0687		0.0562	*J	0.115	*J	0.0659	*J
Orthophosphate	mg/L	0.0163	J	0.0142	*J	0.01	U	--	
Total Kjeldahl Nitrogen	mg/L	--		--		0.99	U	--	
Nitrate-Nitrite	mg/L	--		--		0.351	*J	--	
<b>Metals</b>									
Total Recoverable Copper	ug/L	16		11.4	*J	28.1	*J	--	
Dissolved Copper	ug/L	3.99		4.51	J	9.9	*J	--	
Total Recoverable Zinc	ug/L	62.8		56	J	128	*J	--	
Dissolved Zinc	ug/L	16.8		26	J	32.1	*J	--	
<b>Particle Size Distribution</b>									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.01	U	--		--		--	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	4.04		--		--		--	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.01	U	--		--		--	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		--		--	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		--		--	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	21.85		--		--		--	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	5.96		--		--		--	

Pilchuck VFS (cont.)	Storm Report								
PARAMETER	UNITS	2/28/2013		3/2/2013		3/20/2013		1/7/2014	
Conventionals									
TSS	mg/L	66		77		53		62	
Hardness as CaCO <sub>3</sub>	mg/L	29.7		22.8		36		30.4	
Nutrients									
Total Phosphorous	mg/L	0.104		0.0947		--		0.0987	
Orthophosphate	mg/L	0.01	U	--		0.01	U	0.01	U
Total Kjeldahl Nitrogen	mg/L	1.1	J	0.57	J	0.66	J	1.1	
Nitrate-Nitrite	mg/L	0.089		0.078		0.115		0.206	
Metals									
Total Recoverable Copper	ug/L	30.7		--		22.3		26.4	
Dissolved Copper	ug/L	6.3		--		6.75		4.66	
Total Recoverable Zinc	ug/L	130		--		87.9		125	
Dissolved Zinc	ug/L	15.6		--		16.2		20.8	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.7		--		1		1.31	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	12.3		--		8.21		7.59	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.56		--		6.68		0.92	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	30.69		--		36.06		29.47	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	16.14		--		10.12		9.21	

Pilchuck VFS (cont.)	Storm Report								
PARAMETER	UNITS	1/29/2014		3/19/2014		4/8/2014		6/12/2014	
Conventionals									
TSS	mg/L	54	*J	57		34		80	*R
Hardness as CaCO <sub>3</sub>	mg/L	36.6	*J	24.1		24.6		39	*R
Nutrients									
Total Phosphorous	mg/L	0.112	*J	0.09		0.0751		0.173	*R
Orthophosphate	mg/L	0.01	U	--		0.0125		--	
Total Kjeldahl Nitrogen	mg/L	0.93	J	--		--		1.66	*R
Nitrate-Nitrite	mg/L	0.363	*J	--		--		0.21	*R
Metals									
Total Recoverable Copper	ug/L	24.2	*J	--		17.8		--	
Dissolved Copper	ug/L	5.91	J	--		5.97		--	
Total Recoverable Zinc	ug/L	118	*J	--		66.8		--	
Dissolved Zinc	ug/L	21.4	J	--		14.9		--	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	4.31	*J	1.35		10.48		0.01	U
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	6.76	*J	6.23		2.97		4.39	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.65	*J	1.91		1.01		0.21	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.48		0.03	*R
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	45.33	*J	47.7		28.01		71.06	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	9.34	*J	6.6		2.2		5.16	*R

Pilchuck VFS (cont.)		Storm Report							
PARAMETER	UNIT S	11/6/2014		12/19/2014		3/31/2015		4/11/2015	
<b>Conventionals</b>									
TSS	mg/L	25		76		55		190	*R
Hardness as CaCO <sub>3</sub>	mg/L	27		41		23		32	*R
<b>Nutrients</b>									
Total Phosphorous	mg/L	0.086		0.077		0.193		0.704	*R
Orthophosphate	mg/L	0.037	J	0.027		0.016		0.163	*R
Total Kjeldahl Nitrogen	mg/L	2.7		1.59		0.45		0.75	*R
Nitrate-Nitrite	mg/L	0.3		0.2	J	0.47	J	1.1	J
<b>Metals</b>									
Total Recoverable Copper	ug/L	12.4		21.2		27.4		37.9	*R
Dissolved Copper	ug/L	2.13	H	3.9	H	8.18	H	17.8	H
Total Recoverable Zinc	ug/L	47.2		114		110		181	*R
Dissolved Zinc	ug/L	7.21	H	18.7	H	14.3	H	50.8	H
<b>Particle Size Distribution</b>									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	30.52		--		15.46		64.1	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	24.53		--		3.84		5.9	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	37.22		--		2.27		5.1	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		0.01	U	1.3	*R
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	--		48.89		117.1	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	12.63		--		3.84		5.9	*R

Pilchuck VFS 2m		Storm Report						
PARAMETER		UNITS	10/18/2012		2/28/2013		3/2/2013	
Conventionals								
TSS	mg/L	35	J	--		11	*R	
Hardness as CaCO <sub>3</sub>	mg/L	13.6		25.2	*R	22.2	*R	
Nutrients								
Total Phosphorous	mg/L	0.181		0.0674	*R	0.0952	*R	
Orthophosphate	mg/L	0.0851	J	0.0199	*R	--		
Total Kjeldahl Nitrogen	mg/L	--		0.94	U	0.64	J	
Nitrate-Nitrite	mg/L	0.106		0.128		0.096	*R	
Metals								
Total Recoverable Copper	ug/L	16.7		10.7	*R	--		
Dissolved Copper	ug/L	8.94		6.37	*R	--		
Total Recoverable Zinc	ug/L	50.8		28	*R	--		
Dissolved Zinc	ug/L	10.3		11.6	*R	--		
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	2.68		--		0.01	U	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	2.6		--		7.03	*R	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.38		--		0.01	U	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		0.01	U	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	25.63		--		0.01	U	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	3.6		--		3.87	*R	

Pilchuck VFS 2m		Storm Report						
PARAMETER		UNITS	3/20/2013		1/7/2014		11/6/2014	
Conventionals								
TSS	mg/L	23	*J	7	*R	13	*R	
Hardness as CaCO <sub>3</sub>	mg/L	34.2	*J	13.2	*R	22	*R	
Nutrients								
Total Phosphorous	mg/L	0.219	*J	0.0844	*R	0.274	*R	
Orthophosphate	mg/L	0.0949	*J	0.0533	*R	0.183	*R	
Total Kjeldahl Nitrogen	mg/L	0.95	J	0.76	*R	3.43	*R	
Nitrate-Nitrite	mg/L	0.133	*J	0.076	*R	9.3	*R	
Metals								
Total Recoverable Copper	ug/L	10	*J	9.98	*R	76.1	*R	
Dissolved Copper	ug/L	6.32	*J	7.38	*R	61.8	*R	
Total Recoverable Zinc	ug/L	52.7	*J	24.9	*R	42	*R	
Dissolved Zinc	ug/L	18.8	*J	14.9	*R	51	*R	
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	4.67	*J	0.50	*R	17.79	*R	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	1.29	*J	1.82	*R	11.53	*R	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	16.07	*J	0.62	*R	16.6	*R	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	*R	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	*R	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	18.11	*J	2.79	*R	0.01	*R	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.55	*J	1.22	*R	3.44	*R	

Pilchuck VFS 2m		Storm Report					
PARAMETER		UNITS	3/31/2015		4/11/2015		
Conventionals							
TSS	mg/L	46		44			
Hardness as CaCO <sub>3</sub>	mg/L	23		22			
Nutrients							
Total Phosphorous	mg/L	0.17		0.413			
Orthophosphate	mg/L	0.044		0.295			
Total Kjeldahl Nitrogen	mg/L	0.467		0.557			
Nitrate-Nitrite	mg/L	0.75	J	1.6	J		
Metals							
Total Recoverable Copper	ug/L	17.3		29.6			
Dissolved Copper	ug/L	7.38	H	24.5	H		
Total Recoverable Zinc	ug/L	85.7		60.4			
Dissolved Zinc	ug/L	15.5	H	51.6	H		
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	7.61		42.6			
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	4.01		2.8			
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	1.79		2.5			
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U		
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U		
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	45.1		40.5			
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	4.56		3.6			

Pilchuck VFS 4m		Storm Report							
PARAMETER	UNITS	10/18/2012		11/7/2012		12/12/2012		2/21/2013	
<b>Conventionals</b>									
TSS	mg/L	37		62	J	19	J	8	*R
Hardness as CaCO <sub>3</sub>	mg/L	13.7		42.8	*R	22		--	
<b>Nutrients</b>									
Total Phosphorous	mg/L	0.27		0.583	*R	0.111		--	
Orthophosphate	mg/L	0.158	J	--		0.0479		0.208	*R
Total Kjeldahl Nitrogen	mg/L	--		0.79	U	0.37	J	--	
Nitrate-Nitrite	mg/L	0.079		0.314	*R	0.147		--	
<b>Metals</b>									
Total Recoverable Copper	ug/L	18		12.5	*R	8.18		9.16	*R
Dissolved Copper	ug/L	11.9		4.23	J	4.76		7.1	*R
Total Recoverable Zinc	ug/L	38.1		228	*R	24.6		64.3	*R
Dissolved Zinc	ug/L	12.8		166	J	14		54.2	*R
<b>Particle Size Distribution</b>									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	6.99		--		3.56		--	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	3.83		--		11.2		--	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.01	U	--		3.95		--	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		0.01	U	--	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	2.88		--		0.01	U	--	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	26.38		--		0.01	U	--	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.81		--		7.31		--	

Pilchuck VFS 4m	Storm Report								
PARAMETER	UNITS	2/25/2013		2/28/2013		3/20/2013		1/28/2014	
Conventionals									
TSS	mg/L	2		--		19		12	
Hardness as CaCO <sub>3</sub>	mg/L	30.8		20.5		30		20.9	
Nutrients									
Total Phosphorous	mg/L	0.175		0.0978		0.334		--	
Orthophosphate	mg/L	0.114		0.0694		0.162		1.03	
Total Kjeldahl Nitrogen	mg/L	1.5	J	0.56	U	1.6		1.5	
Nitrate-Nitrite	mg/L	0.292		0.156		0.262		0.477	
Metals									
Total Recoverable Copper	ug/L	5.48		6.67		9.45		11	
Dissolved Copper	ug/L	5.03		6.22		5.54		8.39	J
Total Recoverable Zinc	ug/L	30.9		20		39.8		28.3	
Dissolved Zinc	ug/L	30.9		15.9		26.3		17.6	J
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		0.8		20.81		1.32	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		0.42		1.42		2.00	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		0.13		16.56		1.44	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		0.01	U	0.01	U	0.43	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		0.01	U	14.17		16.01	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		0.39		1.57		0.43	

Pilchuck VFS 4m	Storm Report								
PARAMETER	UNITS	3/19/2014		4/8/2014		4/22/2014		6/12/2014	
Conventionals									
TSS	mg/L	5		7		4		5	
Hardness as CaCO <sub>3</sub>	mg/L	20.2		--		22.8		25	
Nutrients									
Total Phosphorous	mg/L	0.0950		0.343		0.182		0.584	
Orthophosphate	mg/L	--		0.219		--		--	
Total Kjeldahl Nitrogen	mg/L	1.2		--		1.4		3.6	
Nitrate-Nitrite	mg/L	0.208		--		0.2		0.17	
Metals									
Total Recoverable Copper	ug/L	--		8.77		--		--	
Dissolved Copper	ug/L	--		7.47	J	--		--	
Total Recoverable Zinc	ug/L	--		19		--		--	
Dissolved Zinc	ug/L	--		14.7	J	--		--	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.11		--		0.11		2.18	J
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.61		--		4.57		4.2	J
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.56		--		0.11		0.87	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	2.97		--		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.10		--		0.15		5.45	

Pilchuck VFS 4m		Storm Report					
PARAMETER	UNITS	12/19/2014		3/31/2015		4/11/2015	
Conventionals							
TSS	mg/L	9	*J	7		32	*R
Hardness as CaCO <sub>3</sub>	mg/L	23	*J	23		22	*R
Nutrients							
Total Phosphorous	mg/L	0.269	*J	0.142		0.47	*R
Orthophosphate	mg/L	0.224	*J	0.068		0.282	*R
Total Kjeldahl Nitrogen	mg/L	1.66	*J	0.926		0.722	*R
Nitrate-Nitrite	mg/L	0.22	*J	33	J	0.75	J
Metals							
Total Recoverable Copper	ug/L	8.25	*J	13.4		10.8	*R
Dissolved Copper	ug/L	5.77	H	11.8	H	8.84	H
Total Recoverable Zinc	ug/L	23	*J	38.3		69.4	*R
Dissolved Zinc	ug/L	16.1	H	22.7	H	65.8	H
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L		*J	0.47		3.8	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L		*J	3.42		0.7	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L		*J	0.23		4.7	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L		*J	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L		*J	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L		*J	9.39		21.8	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L		*J	2.24		1.4	*R

Pilchuck CAVFS 2m	Storm Report						
PARAMETER	UNITS	2/21/2013		2/28/2013		4/8/2014	
Conventionals							
TSS	mg/L	27	*R	16	*J	28	*R
Hardness as CaCO <sub>3</sub>	mg/L	49.7	*R	--		26.2	*R
Nutrients							
Total Phosphorous	mg/L	0.898	*R	0.603	*J	0.985	*R
Orthophosphate	mg/L	0.685	*R	0.518	*J	0.242	*R
Total Kjeldahl Nitrogen	mg/L	4.1	*R	--		--	
Nitrate-Nitrite	mg/L	0.764	*R	--		0.107	*R
Metals							
Total Recoverable Copper	ug/L	9.65	*R	6.79	*J	14.2	*R
Dissolved Copper	ug/L	6.64	*R	3.43	*J	4.72	J
Total Recoverable Zinc	ug/L	35.8	*R	28.7	*J	33.6	*R
Dissolved Zinc	ug/L	19.2	*R	14.9	*J	11.6	J
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.01	U	1.02	*J	5.34	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.8	*R	8.1	*J	1.66	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	1.02	*R	0.38	*J	1.11	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.36	*R
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	10.01	*R
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	21.59	*R	0.01	U	18.35	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	1.51	*R	4.9	*J	1.09	*R

Pilchuck CAVFS 2m		Storm Event					
PARAMETER	UNITS	6/12/2014		10/14/2014		8/14/2015	
Conventionals							
TSS	mg/L	12	J	42	*R	42	*R
Hardness as CaCO <sub>3</sub>	mg/L	35	*R	29	*R	67	*R
Nutrients							
Total Phosphorous	mg/L	1.74	*R	1.38	*R	2.07	J
Orthophosphate	mg/L	--		0.812	*R	1.58	*R
Total Kjeldahl Nitrogen	mg/L	3.48	*R	2.03	*R	1.1	*R
Nitrate-Nitrite	mg/L	0.28	*R	0.7	J	1.4	*R
Metals							
Total Recoverable Copper	ug/L	--		15	*R	20.6	*R
Dissolved Copper	ug/L	--		6.54	H	18.1	H
Total Recoverable Zinc	ug/L	--		62.6	*R	250	*R
Dissolved Zinc	ug/L	--		45.9	H	210	H
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	7.14	*R	18.07	*R	0.8	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.82	*R	19.69	*R	0.4	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.94	*R	3.61	*R	0.01	U
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.1	*R
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	18.26	*R	0.01	U	7.2	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	2.6	*R	0.98	*R	0.3	*R

Pilchuck CAVFS 4m		Storm Report						
PARAMETER		UNITS	10/18/2012		2/21/2013		2/25/2013	
Conventionals								
TSS	mg/L	28	*J	6	*J	11	*J	
Hardness as CaCO <sub>3</sub>	mg/L	35.7	*J	34.6	*J	42.7	*J	
Nutrients								
Total Phosphorous	mg/L	1.06	*J	0.836	*J	0.518	*J	
Orthophosphate	mg/L	0.887	J	0.765	*J	0.438	*J	
Total Kjeldahl Nitrogen	mg/L	2	*J	2	J	1.9	J	
Nitrate-Nitrite	mg/L	0.263	*J	1.22	*J	0.703	*J	
Metals								
Total Recoverable Copper	ug/L	25.1	*J	6.39	*J	9.51	*J	
Dissolved Copper	ug/L	21.7	*J	4.07	*J	7.54	*J	
Total Recoverable Zinc	ug/L	29.6	*J	61.9	*J	21.1	*J	
Dissolved Zinc	ug/L	27.5	*J	49	*J	12.2	*J	
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	14.51	*J	0.01	U	0.11	*J	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	2.16	*J	3.4	*J	9.36	*J	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.65	*J	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	24.15	*J	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	2.79	*J	1.56	*J	4.74	*J	

Pilchuck CAVFS 4m		Storm Event						
PARAMETER		UNITS	2/28/2013		3/12/2013		3/20/2013	
Conventionals								
TSS	mg/L	14		15		9	*J	
Hardness as CaCO <sub>3</sub>	mg/L	36.7		36.6		34.7	*J	
Nutrients								
Total Phosphorous	mg/L	0.374		--		0.468	*J	
Orthophosphate	mg/L	0.368		--		--		
Total Kjeldahl Nitrogen	mg/L	1.6		2.4		2	*J	
Nitrate-Nitrite	mg/L	0.513		0.461		0.353	*J	
Metals								
Total Recoverable Copper	ug/L	11.1		--		--		
Dissolved Copper	ug/L	9.26		--		--		
Total Recoverable Zinc	ug/L	28.4		--		--		
Dissolved Zinc	ug/L	21.2		--		--		
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	2.37		19.03		14.95	*J	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	10.3		0.01	U	0.7	*J	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.23		16.71		18.77	*J	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	0.01	U	7.29	*J	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	4.52		0.01	U	1.37	*J	

Pilchuck CAVFS 4m		Storm Event					
PARAMETER	UNITS	4/12/2013		1/7/2014		3/19/2014	
Conventionals							
TSS	mg/L	16	*R	15	*R	7	*R
Hardness as CaCO <sub>3</sub>	mg/L	45.9	*R	48.4	*R	37.3	*R
Nutrients							
Total Phosphorous	mg/L	0.585	J	0.250	*R	0.297	*R
Orthophosphate	mg/L	--		0.195	*R	--	
Total Kjeldahl Nitrogen	mg/L	1	U	1.2	*R	1.4	*R
Nitrate-Nitrite	mg/L	0.098	*R	0.297	*R	0.096	*R
Metals							
Total Recoverable Copper	ug/L	--		18.2	*R	--	
Dissolved Copper	ug/L	--		16.1	*R	--	
Total Recoverable Zinc	ug/L	--		22.1	*R	--	
Dissolved Zinc	ug/L	--		15.9	*R	--	
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	11.78	*R	0.24	*R	0.32	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	10.58	*R	2.44	*R	2.31	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	9.11	*R	0.36	*R	0.42	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	10.59	*R	11.45	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	5.43	*R	1.83	*R	1.06	*R

Pilchuck CAVFS 4m		Storm Event					
PARAMETER	UNITS	4/8/2014		10/14/2014		3/31/2015	
Conventionals							
TSS	mg/L	10	*R	110	*R	7	*J
Hardness as CaCO <sub>3</sub>	mg/L	25.3	*R	40	*R	46	*J
Nutrients							
Total Phosphorous	mg/L	0.878	*R	0.546	J	0.252	*J
Orthophosphate	mg/L	0.645	*R	0.235	*R	0.144	*J
Total Kjeldahl Nitrogen	mg/L	5.6	*R	2.03	*R	0.591	*J
Nitrate-Nitrite	mg/L	0.121	*R	0.21	J	0.6	J
Metals							
Total Recoverable Copper	ug/L	10.6	*R	30.1	*R	15.9	*J
Dissolved Copper	ug/L	9.04	*R	22.4	H	14.4	H
Total Recoverable Zinc	ug/L	23.6	*R	33.3	*R	36.2	*J
Dissolved Zinc	ug/L	15.1	*R	24.9	HJ	15.7	H
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	0.01	U	1.06	*R	2.15	*J
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	1.37	*R	8.94	*R	1.19	*J
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.55	*R	0.21	J	0.21	*J
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	1.65	*R	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	15.02	*R	0.01	U	9.52	*J
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.64	*R	1.62	J	1.11	*J

Pilchuck MVFS	Storm Event								
PARAMETER	UNITS	3/12/2013		3/20/2013		4/4/2013		1/28/2014	
Conventionals									
TSS	mg/L	46		49		53		--	
Hardness as CaCO <sub>3</sub>	mg/L	32.8		33.8		45.3		--	
Nutrients									
Total Phosphorous	mg/L	0.116		0.101		0.222		--	
Orthophosphate	mg/L	--		--		--		--	
Total Kjeldahl Nitrogen	mg/L	0.91	J	0.56	J	2.7		0.86	
Nitrate-Nitrite	mg/L	0.12		0.092		0.345		--	
Metals									
Total Recoverable Copper	ug/L	--		--		--		--	
Dissolved Copper	ug/L	--		--		--		--	
Total Recoverable Zinc	ug/L	--		--		--		--	
Dissolved Zinc	ug/L	--		--		--		--	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		5.49		--		1.41	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		8.51		--		8.28	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		10.68		--		5.65	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.01	U	--		0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		0.01	U	--		0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		40.15		--		41.27	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		11.33		--		8.74	

Pilchuck MVFS		Storm Report					
PARAMETER	UNITS	3/14/2014		3/19/2014		5/23/2014	
<b>Conventionals</b>							
TSS	mg/L	33		67		60	
Hardness as CaCO <sub>3</sub>	mg/L	33.5		31.5		34	
<b>Nutrients</b>							
Total Phosphorous	mg/L	0.102		0.103		0.244	
Orthophosphate	mg/L	0.0157	J	--		--	
Total Kjeldahl Nitrogen	mg/L	0.77		0.43	J	2.59	
Nitrate-Nitrite	mg/L	0.112		0.344		0.4	
<b>Metals</b>							
Total Recoverable Copper	ug/L	21.8		--		--	
Dissolved Copper	ug/L	7.87		--		--	
Total Recoverable Zinc	ug/L	78.4	J	--		--	
Dissolved Zinc	ug/L	22.2		--		--	
<b>Particle Size Distribution</b>							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	4.74		2.38		1.03	J
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	4.45		7.2		5.39	J
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.23		0.91		0.41	J
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	UJ
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.11		0.01	U	2.45	J
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	31.78		49.86		53.43	J
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	2.34		7.20		2.45	J

Pilchuck MVFS		Storm Event					
PARAMETER	UNITS	6/12/2014		10/14/2014		12/19/2014	
Conventionals							
TSS	mg/L	40		39	*R	83	*R
Hardness as CaCO <sub>3</sub>	mg/L	33		17	*R	37	*R
Nutrients							
Total Phosphorous	mg/L	0.111		0.121	*R	0.207	*R
Orthophosphate	mg/L	--		0.084	*R	0.095	*R
Total Kjeldahl Nitrogen	mg/L	1.95		0.985	*R	2.35	*R
Nitrate-Nitrite	mg/L	0.22		0.87	J	0.49	*R
Metals							
Total Recoverable Copper	ug/L	--		67.8	*R	39.1	*R
Dissolved Copper	ug/L	--		16.8	H	4.64	H
Total Recoverable Zinc	ug/L	--		59.1	*R	178	*R
Dissolved Zinc	ug/L	--		38.5	H	17.1	*R
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.46		2.65	*R	--	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	42.91		27.12	*R	--	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	1.04		2.43	*R	--	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	--	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	--	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	0.01	U	--	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	18.48		7.83	*R	--	

Pilchuck MVFS		Storm Event					
PARAMETER	UNITS	3/14/2015		3/31/2015		8/15/2015	
Conventionals							
TSS	mg/L			76		180	*R
Hardness as CaCO <sub>3</sub>	mg/L	50		25		51	*R
Nutrients							
Total Phosphorous	mg/L	1.69		0.152		0.349	J
Orthophosphate	mg/L	0.048	J	0.007		0.086	*R
Total Kjeldahl Nitrogen	mg/L	1.27		0.469		1.01	*R
Nitrate-Nitrite	mg/L	0.75		0.76	J	0.74	*R
Metals							
Total Recoverable Copper	ug/L	122		24.2		53.3	*R
Dissolved Copper	ug/L	7.11	R	4.81	H	13.5	H
Total Recoverable Zinc	ug/L	248		132		205	*R
Dissolved Zinc	ug/L	30.3	R	23.2	H	12.7	H
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	188.55		29.97		1.4	*R
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	3.17		5.78		15.2	*R
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	14.76		2.42		0.8	*R
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	11.36		0.01	U	22.6	*R
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	46.72		65.86		109.3	*R
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	2.27		7.16		16.9	*R

Pilchuck MVFS 2m	Storm Report								
PARAMETER	UNITS	3/12/2013		4/4/2013		1/28/2014		3/14/2014	
Conventionals									
TSS	mg/L	37		29		14		16	
Hardness as CaCO <sub>3</sub>	mg/L	29.1		55.3		28.5		35.5	
Nutrients									
Total Phosphorous	mg/L	0.992		3.35		0.316		0.938	
Orthophosphate	mg/L	--		--		0.247		0.676	J
Total Kjeldahl Nitrogen	mg/L	--		11	J	1.6		5.1	
Nitrate-Nitrite	mg/L	0.766		0.164		0.611		0.804	
Metals									
Total Recoverable Copper	ug/L	--		--		15.6		8.74	
Dissolved Copper	ug/L	--		--		4.67	J	5.5	
Total Recoverable Zinc	ug/L	--		--		62.2		51.6	J
Dissolved Zinc	ug/L	--		--		31	J	26.6	
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	--		14.86		6.43		1.7	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	--		0.88		1.15		0.64	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	--		6.47		4.58		1.91	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	--		0.09		0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	--		17.81		0.28		0.03	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	--		7.19		10.99		10.91	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	--		0.35		0.30		0.61	

Pilchuck MVFS 2m		Storm Report						
PARAMETER		UNITS	3/19/2014		5/23/2014		6/12/2014	
Conventionals								
TSS	mg/L	11		35	J	7		
Hardness as CaCO <sub>3</sub>	mg/L	33.5		98	J	35		
Nutrients								
Total Phosphorous	mg/L	0.287		0.239	J	1.51		
Orthophosphate	mg/L	--		--		--		
Total Kjeldahl Nitrogen	mg/L	1.7		2.58	J	3.49		
Nitrate-Nitrite	mg/L	1.06		0.16	J	0.29		
Metals								
Total Recoverable Copper	ug/L	--		--		--		
Dissolved Copper	ug/L	--		--		--		
Total Recoverable Zinc	ug/L	--		--		--		
Dissolved Zinc	ug/L	--		--		--		
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	8.66		2.46	J	0.84		
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.28		2.83	J	0.26		
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	2.01		0.82	J	0.42		
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.28	J	0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01		27.34	J	0.01	U	
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	2.61		8.95	J	11.12		
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.11		0.93	J	1.24		

Pilchuck MVFS 2m	Storm Report								
PARAMETER	UNIT S	10/14/2014		12/19/2014		3/31/2015		8/15/2015	
Conventionals									
TSS	mg/L	39		25	*R	17	*J		
Hardness as CaCO <sub>3</sub>	mg/L	23		28	*R	17	*J		
Nutrients									
Total Phosphorous	mg/L	3.03	J	2.19	*R	0.59	*J	1.98	J
Orthophosphate	mg/L	2.25		1.36	*R	0.404	*J		
Total Kjeldahl Nitrogen	mg/L	7.53	J	3.63	*R	0.961	*J	1.31	J
Nitrate-Nitrite	mg/L	0.85	J	1	J	0.96	J		
Metals									
Total Recoverable Copper	ug/L	13		13.7	*R	8.76	*J		
Dissolved Copper	ug/L	7.44	H	7.24	H	5.97	H	25.2	H
Total Recoverable Zinc	ug/L	54.2		66.6	*R	58.1	*J		
Dissolved Zinc	ug/L	51.1	HJ	42.6	H	16.1	H	83.8	H
Particle Size Distribution									
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	25.86		--		6.02	*J		
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	14.18		--		0.97	*J		
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	6.52		--		2.37	*J	1	J
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	--		0.01	U	0.01	UJ
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	--		0.01	U	6.3	J
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	--		9.56	*J	28.3	J
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.95		--		0.92	*J	1.4	J

Pilchuck MVFS 4m		Storm Event						
PARAMETER		UNITS	3/12/2013		3/20/2013		4/4/2013	
Conventionals								
TSS		mg/L	--		75		120	
Hardness as CaCO <sub>3</sub>		mg/L	24.9		31.8		56.5	
Nutrients								
Total Phosphorous		mg/L	1.38		2.06		8.77	
Orthophosphate		mg/L	--		--		--	
Total Kjeldahl Nitrogen		mg/L	--		6.2		39	
Nitrate-Nitrite		mg/L	0.209		0.037		0.042	
Metals								
Total Recoverable Copper		ug/L	--		--		--	
Dissolved Copper		ug/L	--		--		--	
Total Recoverable Zinc		ug/L	--		--		--	
Dissolved Zinc		ug/L	--		--		--	
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)		mg/L	14.03		3.79		13.84	
Particle/Grain Size, Phi Scale >10 (<1.0 um)		mg/L	2.5		3.09		3.51	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)		mg/L	11.17		6.15		12.83	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)		mg/L	0.01		U	0.01	U	11.47
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)		mg/L	0.01		U	1.59		43.93
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)		mg/L	35.85			48.18		17.87
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)		mg/L	3.76			5.55		1.2

Pilchuck MVFS 4m		Storm Report						
PARAMETER		UNITS	1/28/2014		3/14/2014		6/12/2014	
Conventionals								
TSS	mg/L	5		32		26		
Hardness as CaCO <sub>3</sub>	mg/L	21.5		34.7		30		
Nutrients								
Total Phosphorous	mg/L	0.287		2.07		0.838		
Orthophosphate	mg/L	0.235		1.71	J	--		
Total Kjeldahl Nitrogen	mg/L	1.8		8		4.21		
Nitrate-Nitrite	mg/L	0.356		0.144		0.025		
Metals								
Total Recoverable Copper	ug/L	5.4		18.5		--		
Dissolved Copper	ug/L	4.24	J	7.35		--		
Total Recoverable Zinc	ug/L	19.9		45.2	J	--		
Dissolved Zinc	ug/L	13.1	J	27.8		--		
Particle Size Distribution								
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	1.31		0.33		2.78		
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	0.98		3.72		1.61		
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	0.66		2.22		1.5		
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U	
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	4.27		0.08		
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.97		2.24		34.92		
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.51		31.97		4.85		

Pilchuck MVFS 4m		Storm Report					
PARAMETER	UNITS	10/14/2014		3/14/2015		3/31/2015	
Conventionals							
TSS	mg/L	13		16	*R	24	
Hardness as CaCO <sub>3</sub>	mg/L	27		37	*R	20	
Nutrients							
Total Phosphorous	mg/L	0.645	J	3.3	J	2.21	
Orthophosphate	mg/L	0.385		2.62	J	1.2	
Total Kjeldahl Nitrogen	mg/L	1.52		3.55	*R	3.04	
Nitrate-Nitrite	mg/L	0.22	J	1.6	J	1.4	J
Metals							
Total Recoverable Copper	ug/L	16.7		16.9	*R	13.5	
Dissolved Copper	ug/L	13.5	H	12.1	R	7.15	H
Total Recoverable Zinc	ug/L	43.7		55.2	*R	57.3	
Dissolved Zinc	ug/L	32.1	HJ	22	R	16.8	H
Particle Size Distribution							
Particle/Grain Size, Phi Scale <1 (>500 um)	mg/L	2.04		1.24	*R	0.45	
Particle/Grain Size, Phi Scale >10 (<1.0 um)	mg/L	7.83		0.83	*R	2.4	
Particle/Grain Size, Phi Scale 1-2 (250-500 um)	mg/L	1.59		1.24	*R	3.15	
Particle/Grain Size, Phi Scale 2 to 3 (125-250 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 3 to 4 (62.5-125 um)	mg/L	0.01	U	0.01	U	0.01	U
Particle/Grain Size, Phi Scale 4-8 (3.9-62.5 um)	mg/L	0.01	U	8.22	*R	16.28	
Particle/Grain Size, Phi Scale 8-10 (1.0-3.9 um)	mg/L	0.35		0.45	*R	0.85	

---

## **Appendix B: WY13-15 Storm Reports**

---

## Everett VFS

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.47	11/6/2012 22:35		11/7/2012 11:15	12.67	47.74							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	24	11/6/2012 22:50	11/07/2012 1300	4.17	250	6,000	8.98	10.65				
4	7	11/7/2012 0:35	11/7/2012 1:50	1.25	250	1,750	9.44	10.01	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	11/6/2012 22:40	11/7/2012 3:10	4.50	281.24	62.50	281.24	270.44	96.16	3.24	0.66	1.08	0.500
4	11/6/2012 23:15	11/7/2012 1:55	2.67	61.38	22.99	61.38	59.56	97.05	0.84	0.18	0.37	0.053

J=Estimate of Hydrology information.

R = Rejected because the beginning for the storm was not sampled.

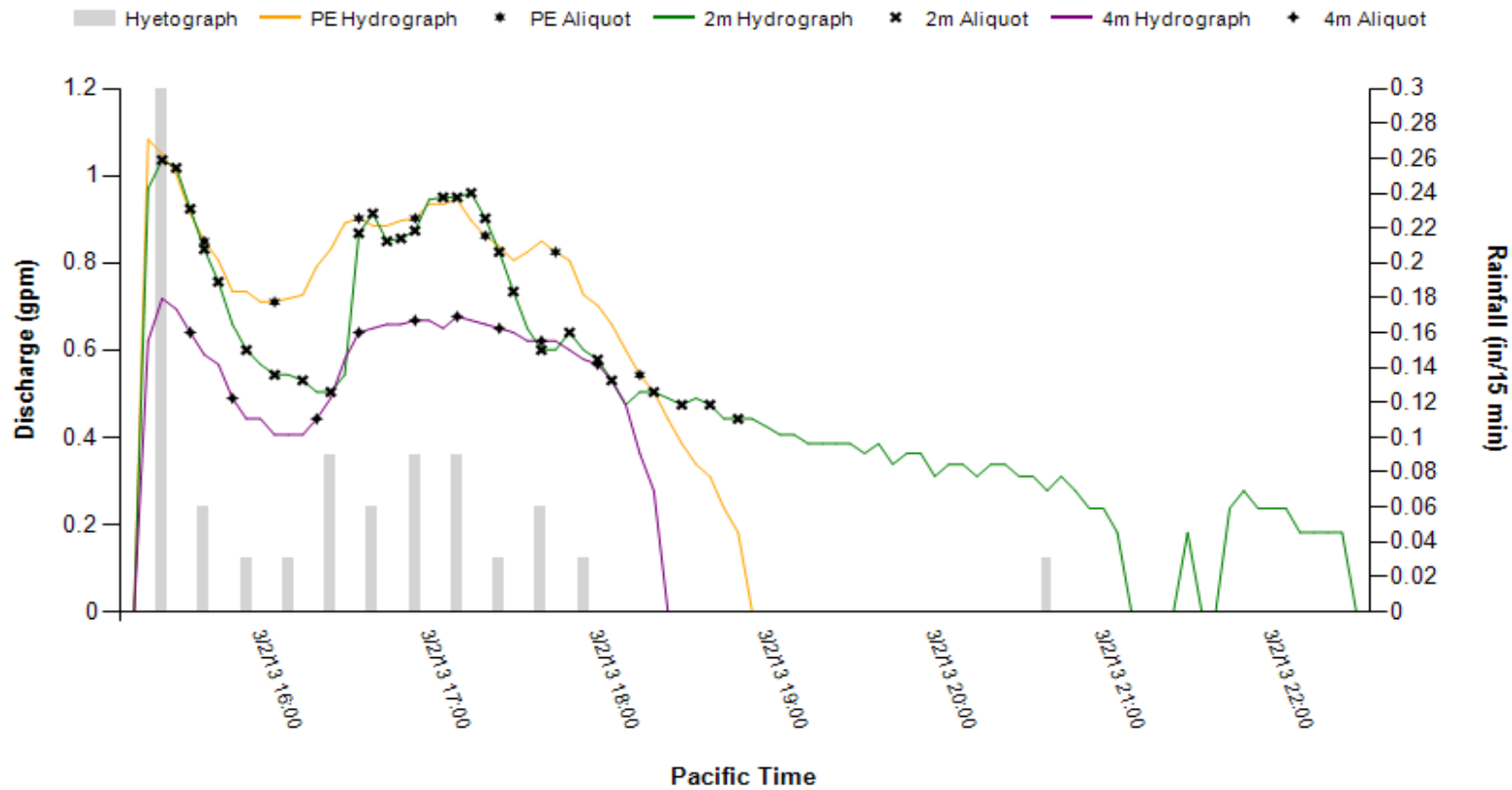
Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.51	12/11/2012 13:45		12/12/2012 7:00	17.25	78							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	N/A	N/A	N/A	N/A	N/A	N/A	5.34	5.97				
4	12	12/11/2012 15:25	12/12/2012 3:40	12.25	250	4,000	5.35	6.50				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	12/11/2012 16:40	12/12/2012 7:25	14.75	525.19	35.61	525.19	N/A	N/A	1.02	0.18	0.66	0.087
4	12/11/2012 15:20	12/12/2012 5:10	13.83	179.68	12.99	179.68	158.55	88.24	0.46	0.18	0.32	0.011

Only grab samples collected at influent.

Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.30	3/2/2013 15:15		3/2/2013 20:30		5.25	45						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)			Min (C°)	Max (C°)
PE	7	3/2/2013 15:40		3/2/2013 18:15		2.58	250	1,750	7.10	9.12	J	
2	28	3/2/2013 15:25		3/2/2013 18:50		3.42	250	7,000	6.79	9.36	J	
4	9	3/2/2013 15:35		3/2/2013 18:00		2.42	250	2,250	7.29	9.12	J	
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/2/2013 15:20	3/2/2013 18:50	3.50	160.90	45.97	160.90	148.92	92.55	1.08	0.18	0.75	0.101
2	3/2/2013 15:20	3/2/2013 22:25	7.08	204.62	28.90	204.62	148.28	72.46	1.04	0.18	0.51	0.090
4	3/2/2013 15:20	3/23/2013 18:20	3.00	105.36	35.12	105.36	97.13	92.19	0.72	0.28	0.57	0.035

J=Estimate of Hydrology information.

## Everett VFS 3/2/2013 Storm Event



Precipitation													
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)							
0.51	3/19/2013 21:15		3/20/2013 11:40		14.42	38.25							
Aliquots							Water Temp		Validation Code				
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)		Min (C°)	Max (C°)		
PE	13	3/19/2013 22:15		3/20/2013 8:35		10.33	250	3,500	6.31	7.63	J		
2	13	3/19/2013 23:55		3/20/2013 10:15		10.33	250	3,250	6.42	9.31	R		
4	15	3/20/2013 0:10		3/20/2013 9:05		8.92	250	3,750	6.46	7.99	R		
Runoff / Discharge													
	Runoff Time			Volume			Sampled		Flow			Stage	
Sample Point (m)	Start Time		End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/19/2013 21:20		3/20/2013 11:10	13.83	506.35	36.61	506.35	396.50	78.3	1.06	0.18	0.65	0.095
2	3/19/2013 23:25		3/20/2013 12:15	12.83	309.15	24.10	309.15	290.07	71.6	0.86	0.18	0.49	0.056
4	3/19/2013 23:30		3/20/2013 9:25	9.92	169.00	17.04	169.00	163.99	97.04	0.53	0.18	0.37	0.016

J=Estimate of Hydrology information.

R = Rejected because the beginning for the storm was not sampled.

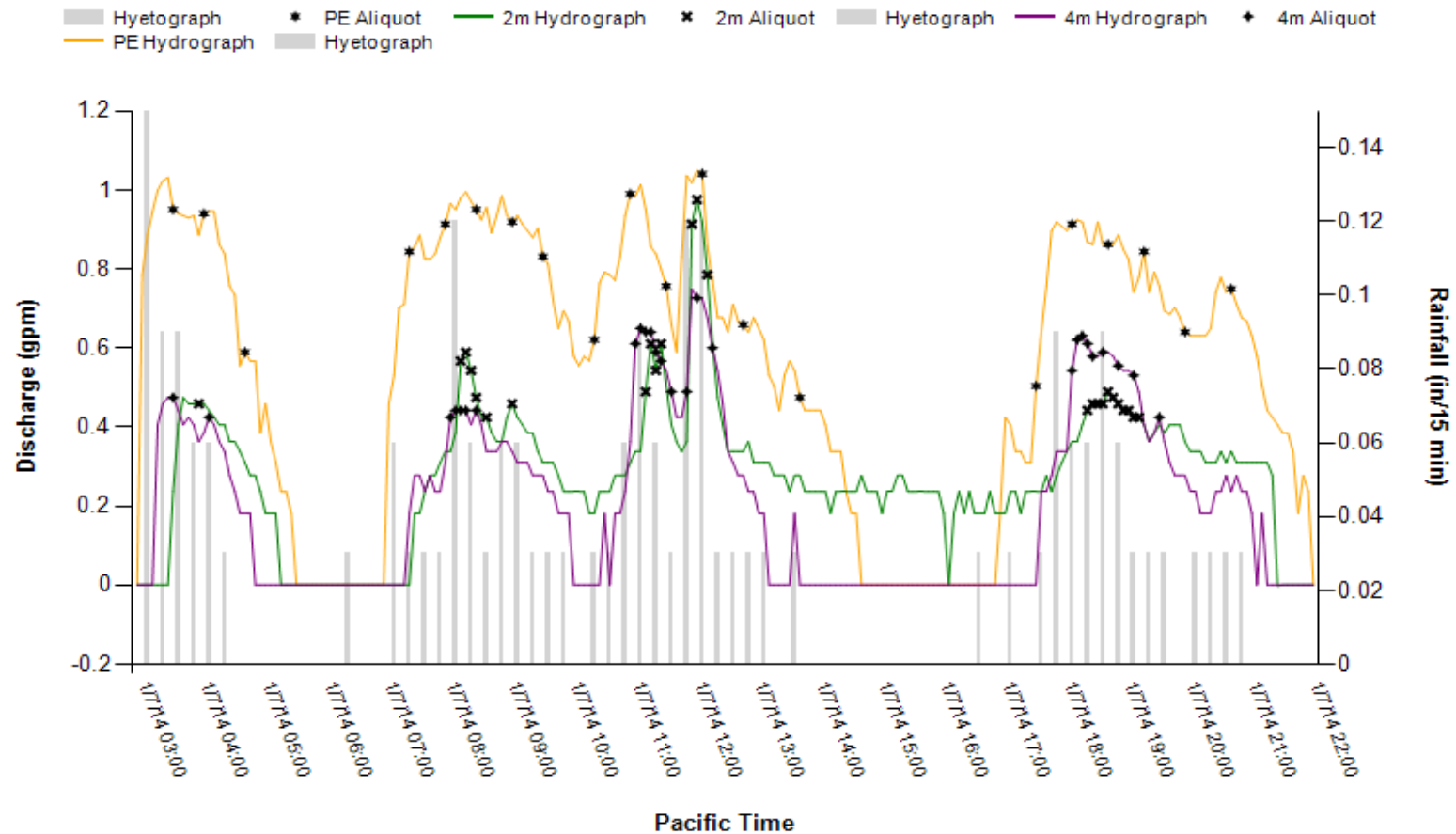
Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.72	5/21/2013 3:15		5/22/2013 2:45	23.50	43.75							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	29	5/21/2013 3:55	5/22/2013 4:30	24.58	250	7,250	8.43	16.25				
2	19	5/21/2013 3:50	5/22/2013 0:30	20.67	250	7,000	10.36	16.25	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	5/21/2013 3:25	5/22/2013 6:15	26.83	922.20	34.37	849.49	882.86	95.80	1.24	0.18	0.53	0.143
2	5/21/2013 3:40	5/22/2013 2:00	22.33	251.48	11.26	251.48	222.55	66.70	0.83	0.18	0.39	0.051

R = Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.81	01/07/2014 02:50		01/07/2014 20:35	17.75	101							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	20	01/07/2014 03:25	01/07/2014 20:35	17.17	250	5,000	2.94	6.97				
2	25	01/07/2014 03:50	01/07/2014 19:05	15.25	250	6,250	3.10	6.97	J			
4	26	01/07/2014 03:25	01/07/2014 19:25	16.00	250	6,500	2.94	6.97				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/07/2014 02:55	01/07/2014 21:50	18.92	642.6	34.0	642.6	608.4	94.70	1.05	0.18	0.70	0.093
2	01/07/2014 03:25	01/07/2014 21:15	17.83	295.56	12.35	295.56	269.4	73.48	0.98	0.18	0.33	0.077
4	01/07/2014 03:10	01/07/2014 21:05	17.92	232.9	13.0	232.9	209.8	90.10	0.75	0.18	0.37	0.039

J=Estimate of Hydrology information.

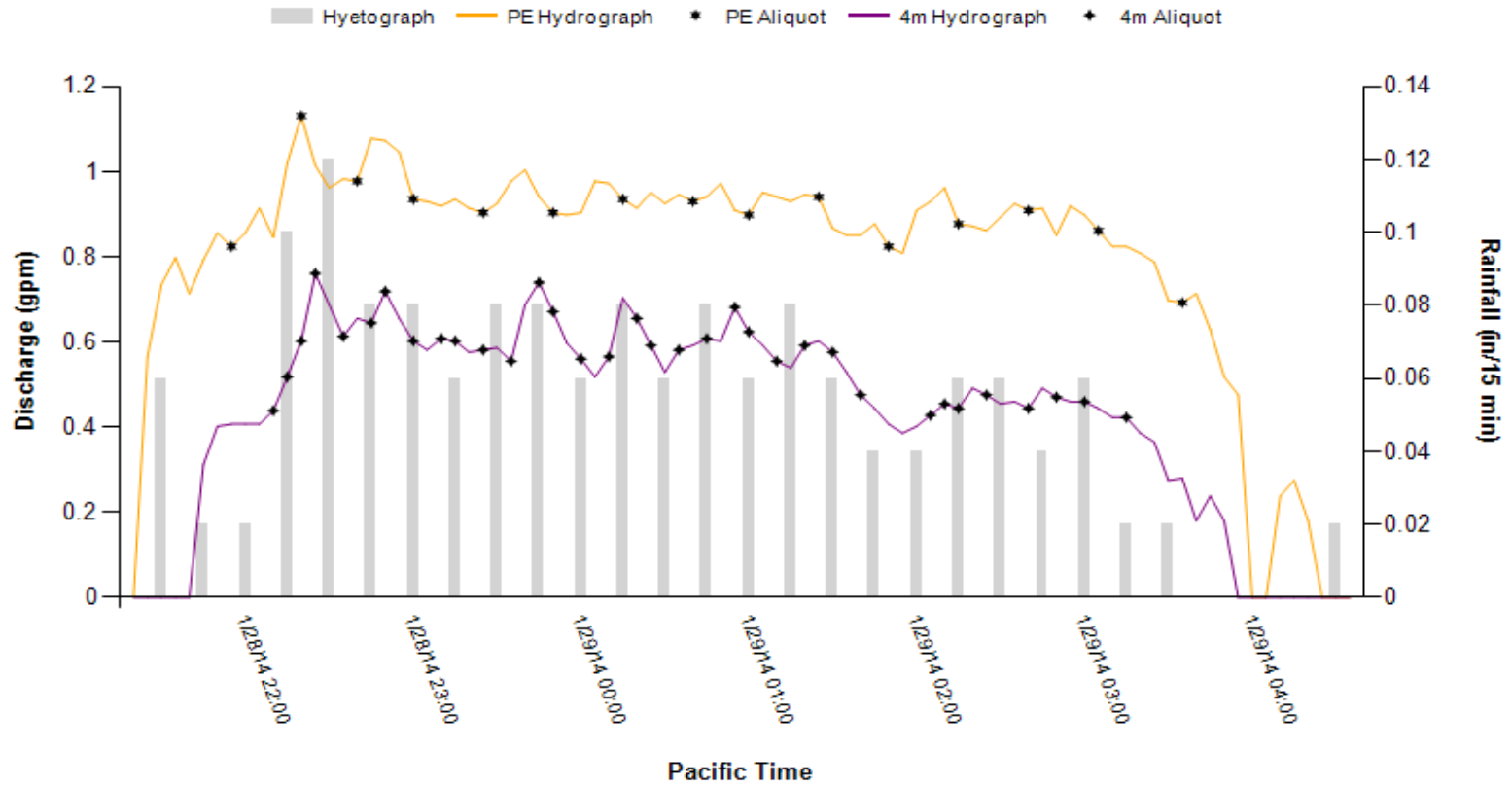
## Everett VFS 1/7/2014 Storm Event



Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.77	01/28/2014 21:20		01/29/2014 04:25	7.08	386.5							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	15	01/28/2014 21:55	01/29/2014 03:35	5.67	250	3,750	6.30	6.93				
2	20	01/28/2014 22:35	01/29/2014 03:15	4.67	250	5,000	6.38	6.93	R			
4	34	01/28/2014 22:10	01/29/2014 03:15	5.08	250	8,500	6.38	6.93				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/28/2014 21:25	01/29/2014 04:20	6.92	352.8	51.0	352.8	337.7	95.70	1.13	0.18	0.86	0.113
2	01/28/2014 22:25	01/29/2014 06:15	7.83	N/A	N/A	N/A	N/A	57.47	0.73	0.18	0.44	0.037
4	01/28/2014 21:45	01/29/2014 03:50	6.08	191.2	31.4	191.2	181.7	95.00	0.76	0.18	0.52	0.041

R = Rejected because less than 75% of the hydrograph was sampled.

## Everett VFS 1/29/2014 Storm Event



Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.50	03/19/2014 03:15		03/19/2014 15:55		12.67	48						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)			Min (C°)	Max (C°)
PE	37	03/19/2014 03:40		03/19/2014 18:50		15.17	250	9,250	6.59	9.49	J	
2	37	03/19/2014 12:05		03/19/2014 20:45		8.67	250	9,250	6.06	9.49	R	
4	14	03/19/2014 12:00		03/19/2014 15:40		3.67	250	3,500	7.45	9.49	R	
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/19/2014 03:15	03/19/2014 17:20	14.08	607.3	43.1	607.3	607.3	87.50	1.18	0.18	0.71	0.126
2	03/19/2014 11:55	03/19/2014 21:45	9.83	N/A	N/A	N/A	N/A	60.81	1.05	0.34	0.54	0.092
4	03/19/2014 11:50	03/19/2014 16:00	4.17	N/A	N/A	N/A	N/A	91.00	0.98	0.27	0.53	0.077

J=Estimate of Hydrology information.

R = Rejected because less than 75% of the hydrograph was sampled and beginning of storm wasn't sampled.

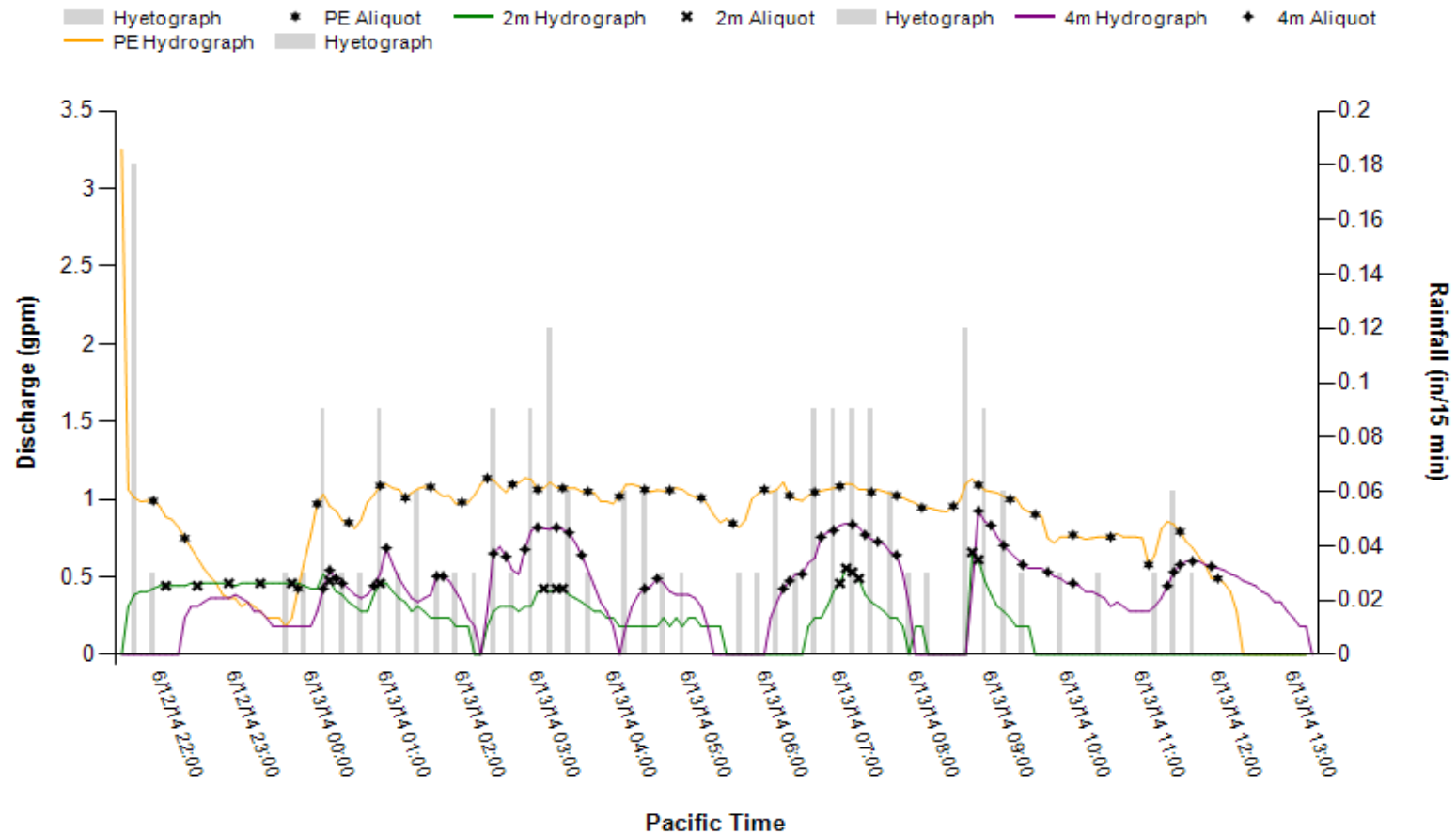
Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.39	04/21/2014 22:40		04/22/2014 08:50	10.17	51							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	24	04/21/2014 23:05	04/22/2014 06:35	7.50	250	6,000	6.67	9.80				
2	37	04/21/2014 23:50	04/22/2014 07:45	7.92	250	9,250	6.57	9.37	R			
4	23	04/21/2014 23:45	04/22/2014 04:45	5.00	250	5,750	7.34	9.37	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/21/2014 22:45	04/22/2014 07:10	8.42	427.4	50.8	427.4	414.4	97.00	0.99	0.18	0.84	0.080
2	04/21/2014 22:40	04/22/2014 08:35	9.92	303.1	30.6	303.1	289.6	56.02	0.66	0.12	0.51	0.028
4	04/21/2014 23:30	04/22/2014 11:45	12.25	254.4	20.8	254.4	152.4	59.90	0.57	0.18	0.35	0.019

R = Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.80	06/12/2014 21:30		06/13/2014 11:35	14.08	79.91							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	37	06/12/2014 21:55	06/13/2014 13:20	15.42	250	9,250	13.20	16.30				
2	16	06/12/2014 22:05	06/13/2014 08:50	10.75	250	4,000	13.20	16.20				
4	37	06/13/2014 00:10	06/13/2014 11:55	11.75	250	9,250	13.20	14.20	J			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	06/12/2014 21:30	06/13/2014 12:15	14.75	801.4	54.3	801.4	795.68	99.29	1.14	0.18	0.89	0.114
2	06/12/2014 21:35	06/13/2014 09:30	11.92	203.6	17.1	203.6	192.5	94.50	0.66	0.18	0.34	0.028
4	06/12/2014 22:20	06/13/2014 13:10	14.83	373.3	25.2	373.3	344.2	92.20	0.92	0.18	0.47	0.067

J=Estimate of Hydrology information.

## Everett VFS 6/12/2014 Storm Event



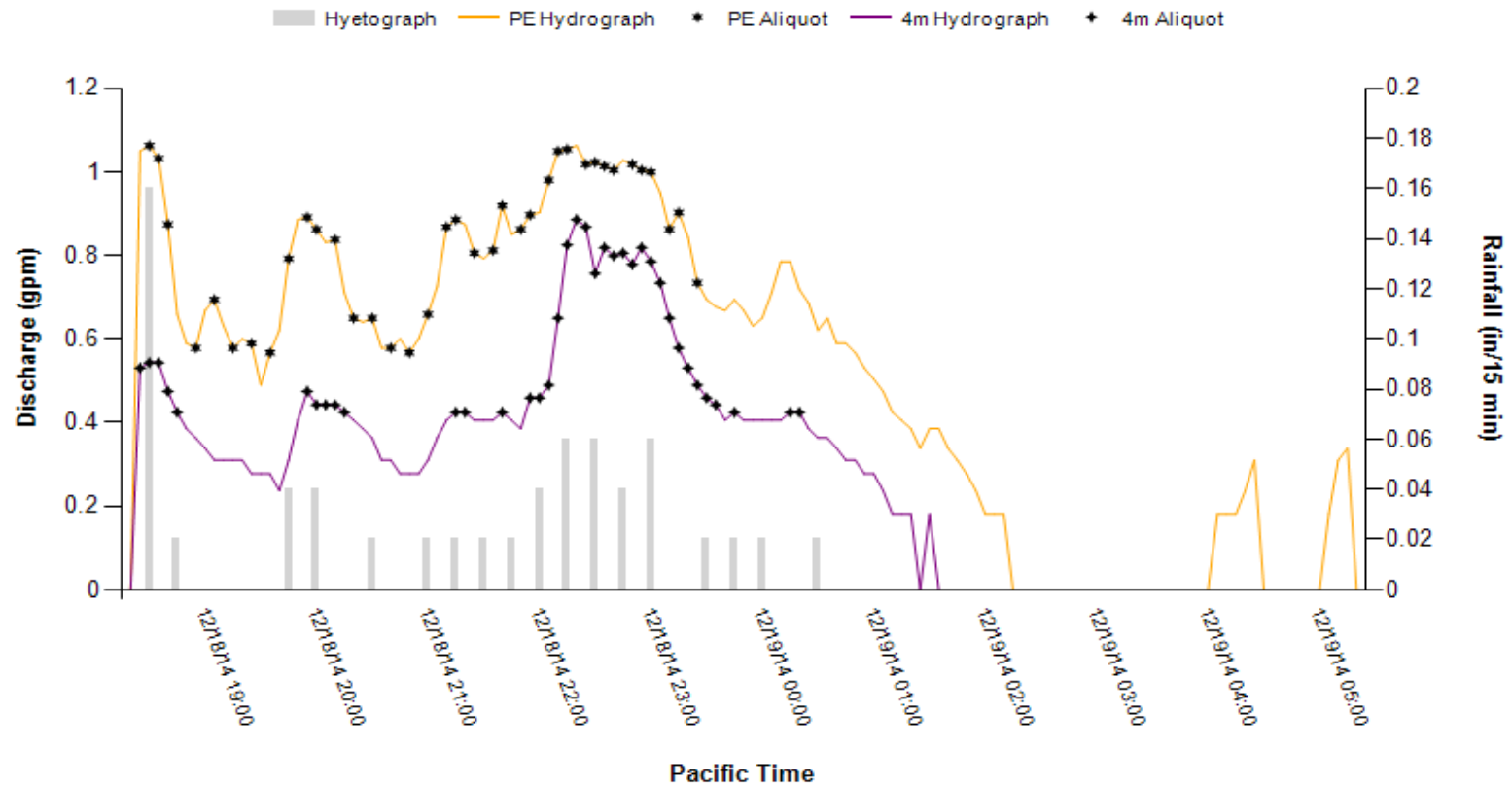
Precipitation												
Total (in)		Start Time		End Time		Duration (hrs)	Antecedent (hrs)					
0.99		10/13/2014 19:05		10/14/2014 04:00		8.92	53.91					
Aliquots								Water Temp		Validation Code		
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)			
PE	17	10/13/2014 20:45		10/14/2014 03:45		7.00	250	4,250	12.20	15.60	J	
2	20	10/13/2014 22:35		10/14/2014 01:50		3.25	250	5,000	12.70	15.10	R	
4	20	10/13/2014 22:40		10/14/2014 01:55		3.25	250	5,000	12.70	14.70	R	
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	10/13/2014 19:10	10/14/2014 04:20	9.17	398.89	43.4	398.89	293.90	73.68	1.38	0.18	0.82	0.189
2	10/13/2014 21:10	10/14/2014 02:05	4.92	140.7	28.6	140.7	135.1	92.08	1.14	0.18	0.74	0.115
4	10/13/2014 19:10	10/14/2014 07:45	12.58	474.2	37.7	474.2	310.0	93.93	1.15	0.18	0.62	0.119

R = Rejected because the beginning for the storm was not sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.35	12/18/2014 18:20		12/19/2014 00:30	6.17	15.08							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	37	12/18/2014 18:30	12/18/2014 23:25	4.92	250	9,250	7.50	7.80	J			
2	15	12/18/2014 18:45	12/18/2014 23:20	4.58	250	3,750	7.50	7.80	R			
4	37	12/18/2014 18:25	12/19/2014 00:20	5.92	250	9,250	7.50	7.90				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	12/18/2014 18:25	12/19/2014 05:15	10.83	331.4	31.5	331.4	246.8	74.47	1.06	0.18	0.67	0.096
2	12/18/2014 18:35	12/18/2014 23:45	5.17	63.8	12.3	63.8	56.4	88.40	0.75	0.18	0.47	0.039
4	12/18/2014 18:25	12/19/2014 01:30	7.08	185.9	26.3	185.9	168.0	90.40	0.89	0.18	0.44	0.060

R = Rejected because the beginning for the storm was not sampled.

## Everett VFS 12/19/2014 Storm Event

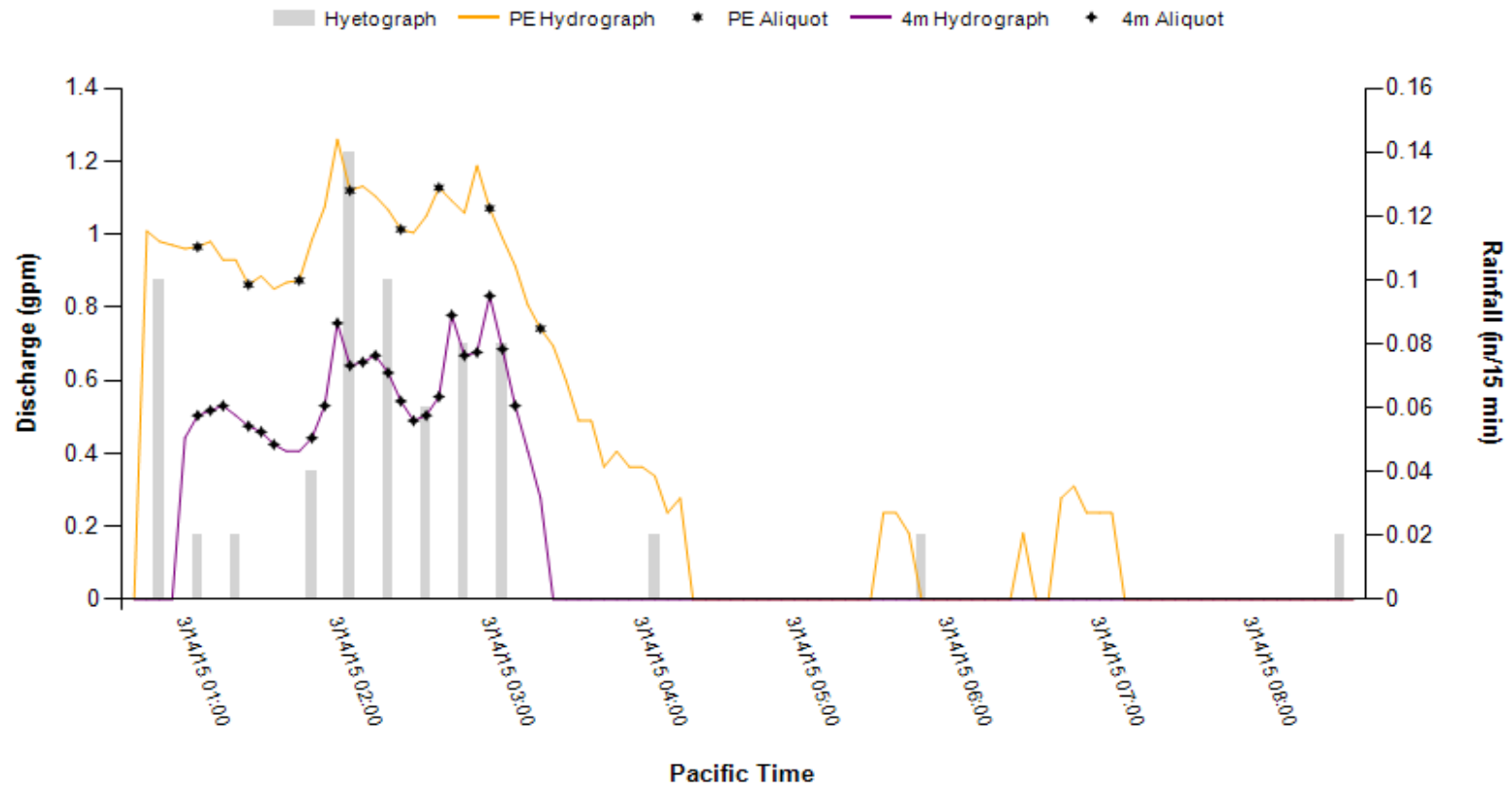


Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.35	03/14/2015 00:40		03/14/2015 08:30	7.83	349.41							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	8	03/14/2015 01:05	03/14/2015 03:20	2.25	250	2,000	11.90	12.20	J			
2	7	03/14/2015 02:05	03/14/2015 03:05	1.00	250	1,750	12.10	12.20	R			
4	20	03/14/2015 01:05	03/14/2015 03:10	2.08	250	5,000	11.90	12.20				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/14/2015 00:45	03/14/2015 07:05	6.33	193.1	30.5	193.1	159.3	82.50	1.26	0.18	0.74	0.149
2	03/14/2015 02:00	03/14/2015 03:10	1.17	40.1	34.2	40.1	38.7	96.50	0.93	0.18	0.57	0.069
4	03/14/2015 01:00	03/14/2015 03:20	2.33	79.6	34.2	79.6	66.21	83.19	0.83	0.28	0.55	0.051

J=Estimate of Hydrology information.

R = Rejected because the beginning for the storm was not sampled.

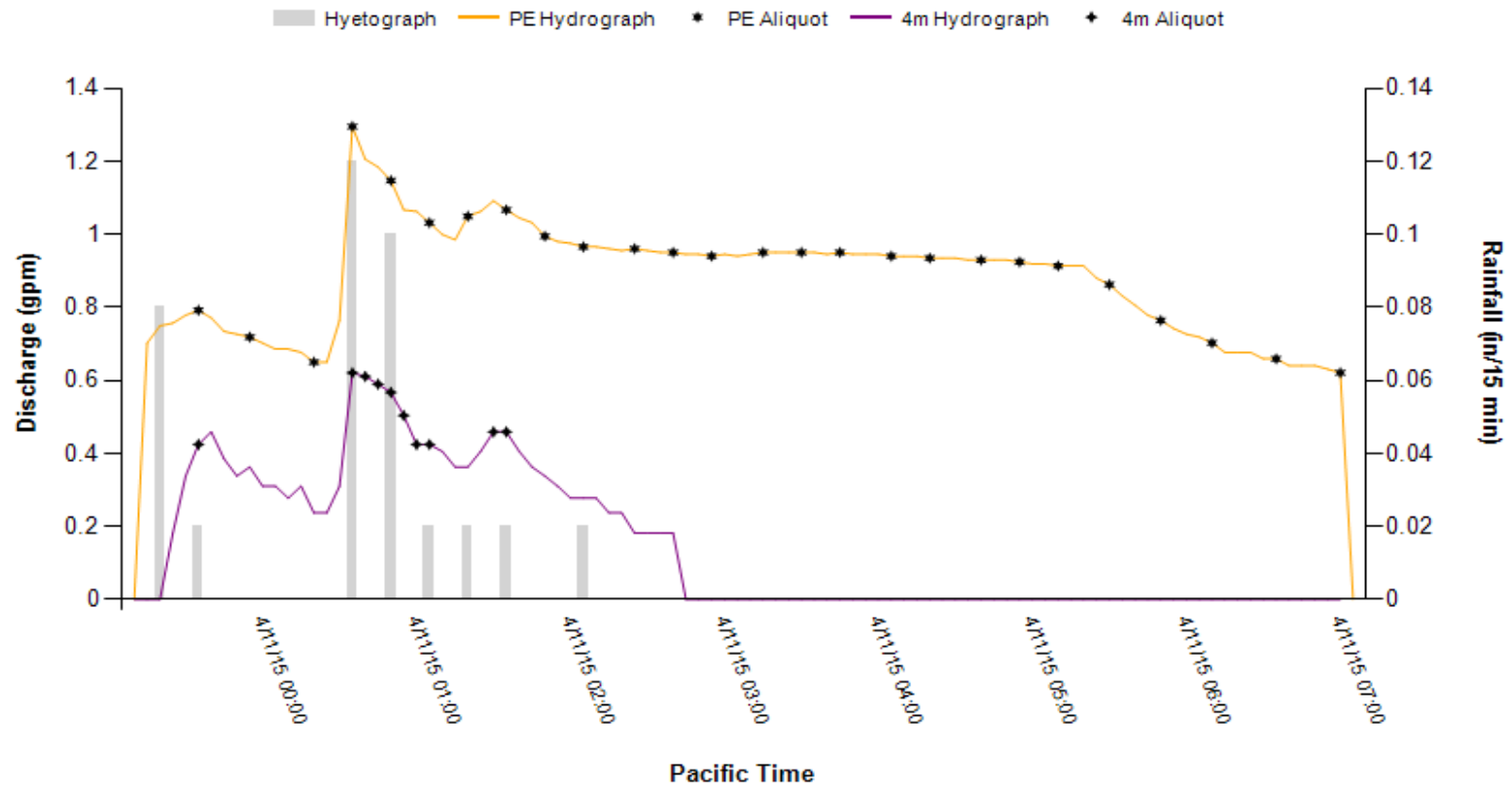
## Everett VFS 3/14/2015 Storm Event



Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.20	04/10/2015 23:10		04/11/2015 02:05		2.92	169.91						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)		Min (C°)	Max (C°)	
PE	26	04/10/2015 23:35		04/11/2015 07:00		7.42	250	6,500	6.10	9.30	J	
4	9	04/10/2015 23:35		04/11/2015 01:35		2.00	250	2,250	8.80	9.30		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/10/2015 23:15	04/11/2015 07:00	7.75	414.0	53.4	414.0	414.0	100.00	1.30	0.62	0.88	0.160
4	04/10/2015 23:25	04/11/2015 02:40	3.25	70.6	21.7	70.6	48.65	68.91	0.62	0.18	0.35	0.024

J=Estimate of Hydrology information.

## Everett VFS 4/11/2015 Storm Event

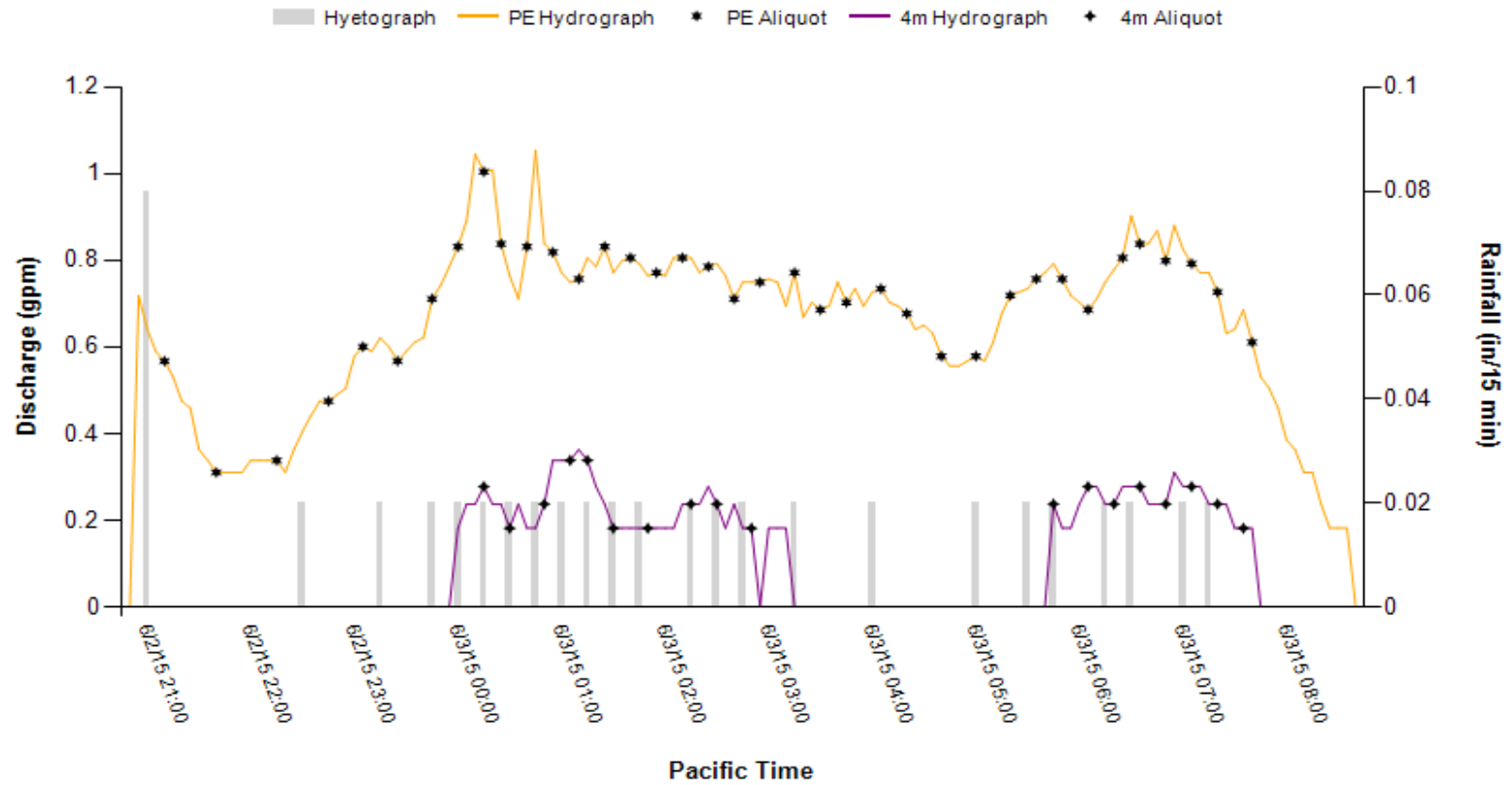


Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.27	06/02/2015 20:50		06/03/2015 07:10	10.33	27.41							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	35	06/02/2015 21:10	06/03/2015 07:40	10.50	250	8,750	12.60	14.80				
2	12	06/02/2015 21:15	06/03/2015 07:10	9.92	250	3,000	12.60	14.70	R			
4	18	06/03/2015 00:15	06/03/2015 07:35	7.33	250	4,500	12.60	13.80	J			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	06/02/2015 20:55	06/03/2015 08:35	11.67	460.0	39.4	460.0	441.8	96.00	1.05	0.18	0.65	0.094
2	06/02/2015 21:00	06/03/2015 07:25	10.42	93.6	9.0	93.6	46.62	49.82	0.56	0.18	0.25	0.018
4	06/03/2015 00:00	06/03/2015 07:40	7.67	72.2	9.4	72.2	71.3	98.70	0.36	0.18	0.23	0.006

J=Estimate of Hydrology information.

R = Rejected because less than 75% of the hydrograph was sampled.

## Everett VFS 6/3/2015 Storm Event



Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.37	08/29/2015 03:40		08/29/2015 10:45	7.08	187							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	10	08/29/2015 04:30	08/29/2015 08:55	4.42	250	2,500	16.90	17.50				
2	8	08/29/2015 06:50	08/29/2015 10:45	3.92	250	2,000	16.90	18.40	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	08/29/2015 03:45	08/29/2015 09:10	5.42	270.0	49.8	270.0	265.6	98.40	1.43	0.24	0.82	0.206
2	08/29/2015 06:30	08/29/2015 13:00	6.50	105.8	16.3	105.8	96.0	90.70	0.79	0.18	0.36	0.045

R = Rejected because the beginning for the storm was not sampled.

## Everett MVFS

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.48	11/6/2012 22:25		11/7/2012 10:15	11.83	48.25							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	29	11/6/2012 22:45	11/7/2012 10:35	11.83	250	7,250	6.73	11.54				
2	10	11/7/2012 0:25	11/7/2012 2:05	1.67	250	4,750	9.62	10.45	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	11/6/2012 22:30	11/7/2012 10:55	12.42	312.99	25.20	312.99	307.18	98.14	1.63	0.18	0.66	0.291
2	11/6/2012 23:05	11/7/2012 11:20	12.25	121.84	9.95	121.84	77.51	63.62	0.75	0.18	0.36	0.039

R = Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.53	12/11/2012 13:45		12/12/2012 6:55		17.17	42.24						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)		Min (C°)	Max (C°)	
PE	N/A	N/A		N/A		N/A	N/A	N/A	5.29	6.50		
4	12	12/11/2012 22:25		12/12/2012 5:00		6.58	250	3,000	5.33	5.64		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	12/11/2012 14:00	12/11/2012 13:45	0.25	595.68	2382.73	519.47	N/A	N/A	1.01	0.18	-0.09	0.085
4	12/11/2012 15:20	12/12/2012 7:20	16.00	208.17	13.01	208.17	191.87	92.17	0.45	0.01	0.11	0.010

Only grab samples collected at influent.

Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.27	3/2/2013 15:15		3/2/2013 17:50		2.58	51.49						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	8	3/2/2013 15:35	3/2/2013 18:45	3.17	250	2,250	6.72	9.70	R			
2	10	3/2/2013 15:40	3/2/2013 18:25	2.75	250	2,500	6.99	9.70	R			
4	13	3/2/2013 16:40	3/2/2013 18:40	2.00	250	3,250	6.85	8.01	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/2/2013 15:15	3/2/2013 22:00	6.75	310.27	45.97	310.27	193.64	62.40	1.25	0.00	0.75	0.146
2	3/2/2013 15:25	3/2/2013 19:15	3.83	124.11	32.40	124.11	106.88	86.12	0.68	0.18	0.53	0.030
4	3/2/2013 16:30	3/2/2013 20:00	3.50	92.75	26.50	92.75	68.90	74.28	0.59	0.10	0.43	0.021

R = Rejected because less than 75% of the hydrograph was sampled and beginning of storm not sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.45	3/19/2013 21:30		03/20/2013 17:40	13.17	38.74							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	16	3/19/2013 22:45	3/20/2013 9:50	11.08	250	4,000	5.77	8.18				
4	19	3/20/2013 0:10	3/20/2013 9:05	8.92	250	4,750	5.77	7.57	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/19/2013 22:00	3/20/2013 11:05	13.08	550.09	42.06	550.09	528.63	96.10	1.09	0.18	0.49	0.103
4	3/19/2013 23:25	3/20/2013 13:55	14.50	255.06	17.59	255.06	207.59	81.39	0.52	0.05	0.33	0.016

R = Rejected because beginning of storm was not sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.17	4/12/2013 13:45		4/12/2013 16:20	2.58	32.5							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	14	4/12/2013 14:05	4/12/2013 16:20	2.25	250	3,500	6.14	7.62				
2	17	4/12/2013 14:45	4/12/2013 18:05	3.33	250	5,750	6.01	7.02	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	4/12/2013 13:55	4/12/2013 16:50	2.92	122.52	41.96	122.52	111.11	90.69	1.00	0.18	0.38	0.082
2	4/12/2013 14:30	4/12/2013 18:55	4.42	137.08	31.01	137.08	122.68	66.00	0.72	0.18	0.22	0.035

R = Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.66	5/21/2013 3:10		5/22/2013 0:25	21.25	44.75							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	22	5/21/2013 3:40	5/22/2013 1:00	21.33	250	5,500	8.83	12.09	J			
2	17	5/21/2013 6:05	5/21/2013 23:15	17.17	250	4,250	8.83	12.09	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	5/21/2013 3:15	5/22/2013 5:55	26.67	801.61	30.06	797.08	797.08	100.00	1.29	0.18	0.58	0.157
2	5/21/2013 5:45	5/22/2013 0:40	18.92	168.67	8.92	168.67	142.23	84.32	0.53	0.18	0.38	0.016

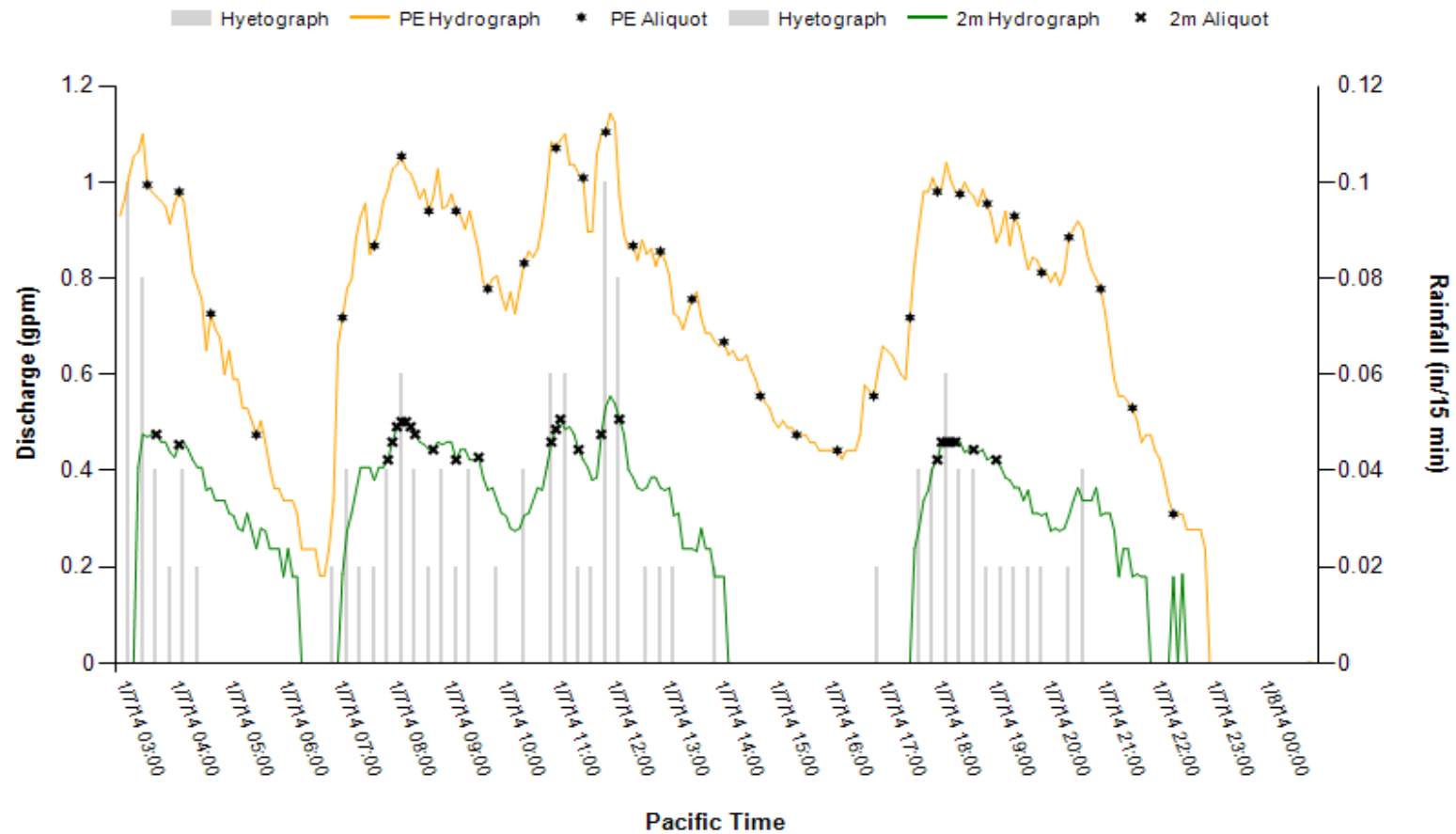
J=Estimate of Hydrology information

R = Rejected because beginning of storm was not sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.77	01/07/2014 02:55		01/07/2014 20:35	17.67	101							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	36	01/07/2014 03:25	01/08/2014 01:25	22.00	250	9,000	2.80	7.06	J			
2	25	01/07/2014 03:35	01/07/2014 19:00	15.42	250	6,250	2.87	7.06	J			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/07/2014 02:55	01/08/2014 00:45	21.83	884.9	40.5	884.9	884.9	100.00	1.14	0.00	0.73	0.116
2	01/07/2014 03:15	01/07/2014 22:25	19.17	316.5	16.5	316.5	265.0	83.70	0.55	0.18	0.36	0.018

J=Estimate of Hydrology information

### Everett MVFS 1/7/2014 Storm Event

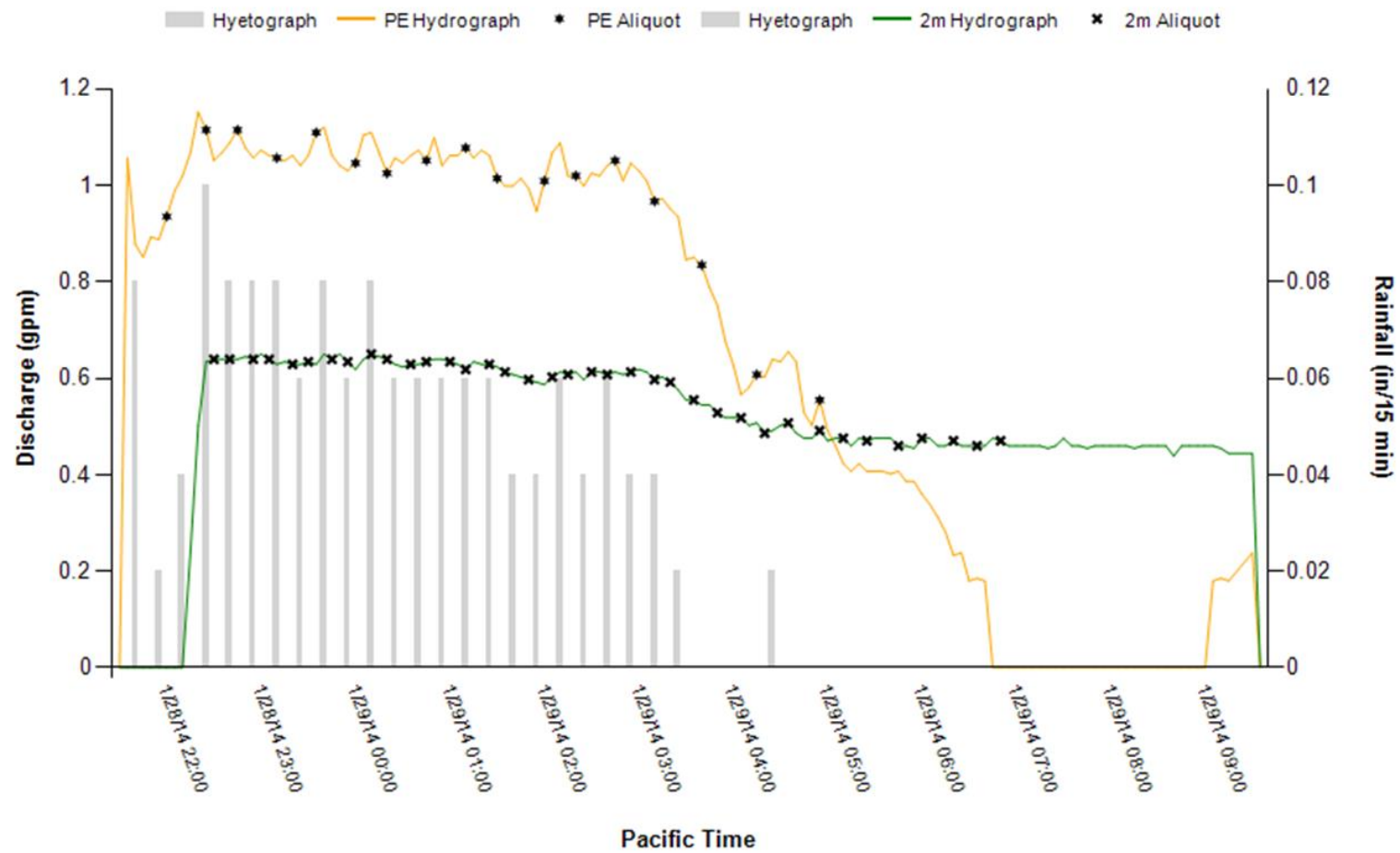


Precipitation												
Total (in)		Start Time		End Time		Duration (hrs)	Antecedent (hrs)					
0.71		01/28/2014 21:30		01/29/2014 04:20		6.83	386.74					
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)		Max (C°)		
PE	17	01/28/2014 22:00		01/29/2014 04:55	6.92	250	4,250	6.34	7.36			
2	37	01/28/2014 22:30		01/29/2014 06:50	8.33	250	9,250	6.21	7.24	J		
4	37	01/28/2014 22:40		01/29/2014 03:30	4.83	250	9,250	6.42	7.24	R		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/28/2014 21:35	01/29/2014 09:30	11.92	467.2	39.2	467.2	426.7	92.10	1.15	0.18	0.82	0.118
2	01/28/2014 22:15	01/29/2014 09:30	11.25	362.3	32.2	362.3	293.6	81.00	0.65	0.24	0.54	0.027
4	01/28/2014 22:30	01/29/2014 09:30	11.00	250.0	22.7	250.0	149.3	59.74	0.57	0.18	0.38	0.019

J=Estimate of Hydrology information

R = Rejected because less than 75% of the hydrograph was sampled and beginning of storm not sampled.

## Everett MVFS 1/28/2014 Storm Event



Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.30	04/08/2014 15:15		04/08/2014 22:10	6.92	58.75							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	19	04/08/2014 15:45	04/09/2014 01:45	10.00	250	4,750	6.58	14.72	J			
2	20	04/08/2014 15:50	04/08/2014 22:05	6.25	250	5,000	9.36	14.72	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/08/2014 15:20	04/09/2014 02:35	11.25	406.1	36.1	406.1	396.9	97.70	1.20	0.18	0.68	0.132
2	04/08/2014 15:35	04/09/2014 03:35	12.00	202.5	16.9	202.5	134.3	66.30	0.55	0.18	0.30	0.018

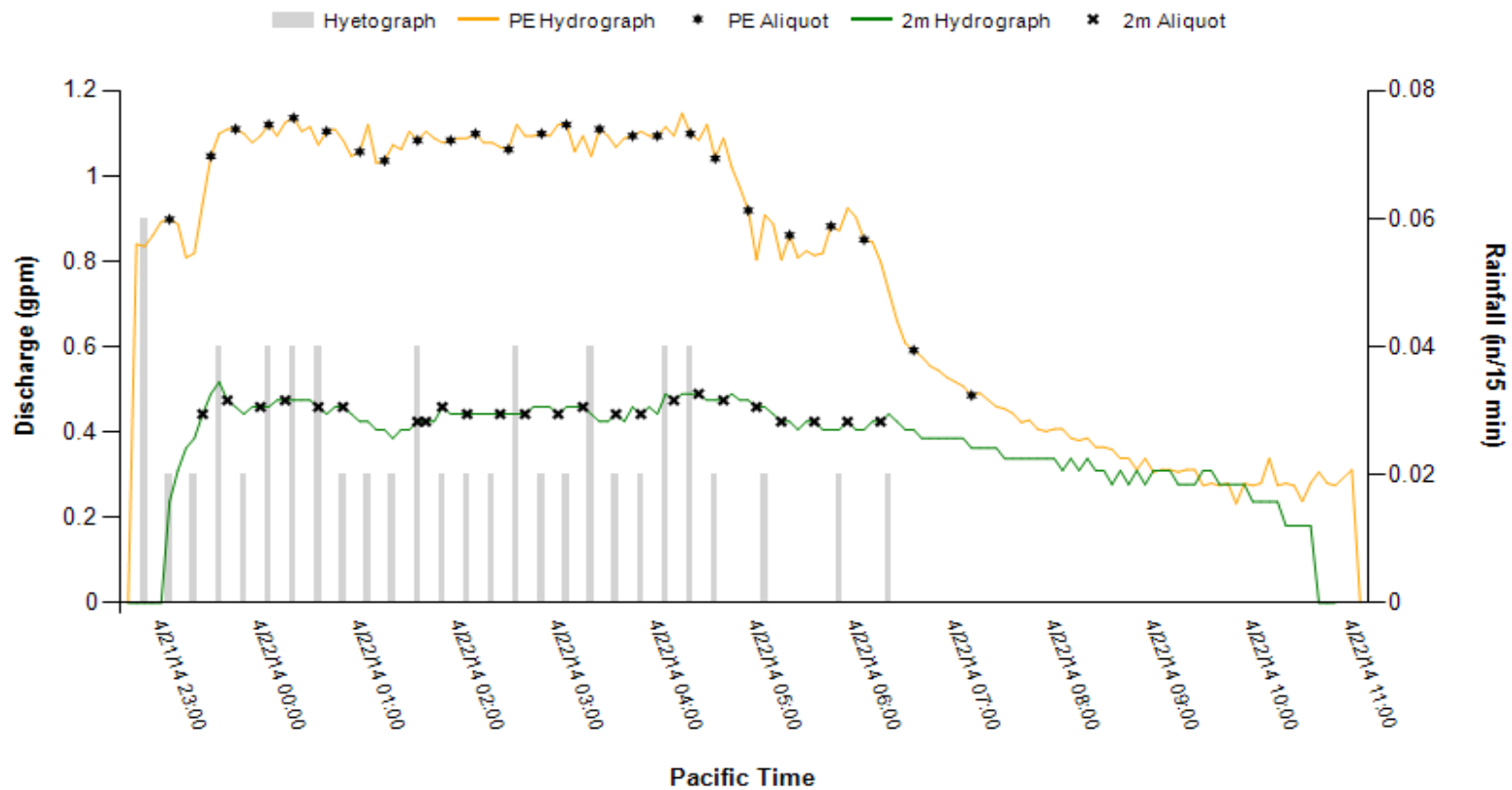
J=Estimate of Hydrology information

Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.38	04/21/2014 22:40		04/22/2014 06:10		7.50	51						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)		Min (C°)	Max (C°)	
PE	25	04/21/2014 23:05		04/22/2014 07:10		8.08	250	6,250	6.39	9.99		
2	24	04/21/2014 23:25		04/22/2014 06:15		6.83	250	6,000	6.60	9.77	J	
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/21/2014 22:45	04/22/2014 11:00	12.25	572.7	46.8	572.7	496.4	86.70	1.15	0.23	0.78	0.116
2	04/21/2014 23:05	04/22/2014 10:35	11.50	273.4	23.8	273.4	191.7	70.10	0.52	0.18	0.39	0.015

J=Estimate of Hydrology information

## Everett MVFS 4/22/2014 Storm Event

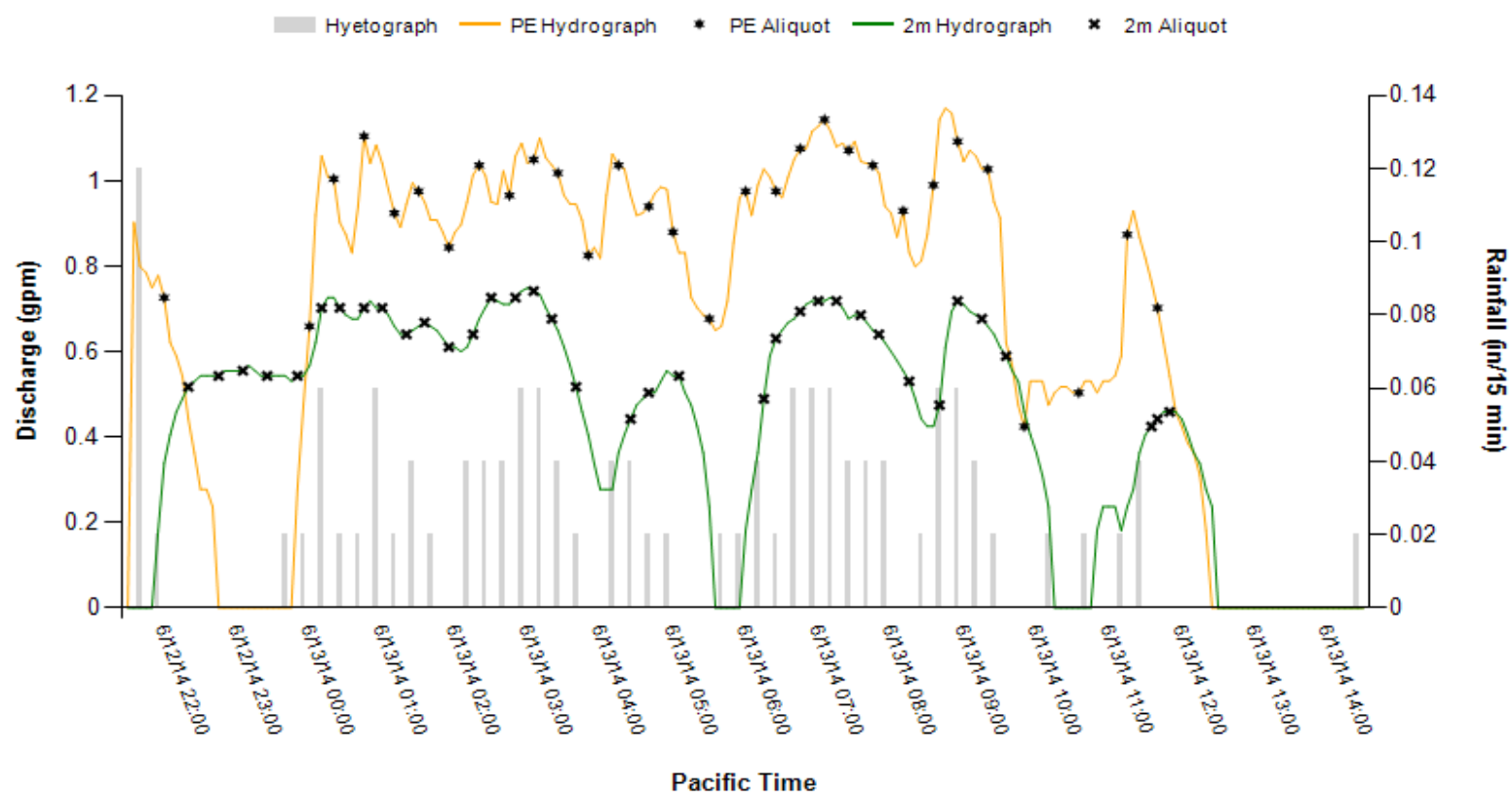


Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.78	06/12/2014 21:30		06/13/2014 14:15		16.75	76.41						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	30	06/12/2014 22:00	06/13/2014 11:40	13.67	250	7,500	12.90	15.90				
2	36	06/12/2014 22:20	06/13/2014 11:50	13.50	250	9,000	12.90	15.60	J			
4	36	06/13/2014 00:40	06/13/2014 10:05	9.42	250	9,000	12.90	13.80	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	06/12/2014 21:35	06/13/2014 12:20	14.75	691.0	46.8	691.0	674.6	97.60	1.17	0.18	0.84	0.123
2	06/12/2014 21:55	06/13/2014 12:25	14.50	442.7	30.5	442.7	430.1	78.96	0.75	0.18	0.54	0.039
4	06/12/2014 22:00	06/13/2014 16:30	18.50	640.0	34.6	640.0	433.2	67.69	0.75	0.18	0.57	0.039

J=Estimate of Hydrology information

Rejected because less than 75% of the hydrograph was sampled.

## Everett MVFS 6/13/2014 Storm Event

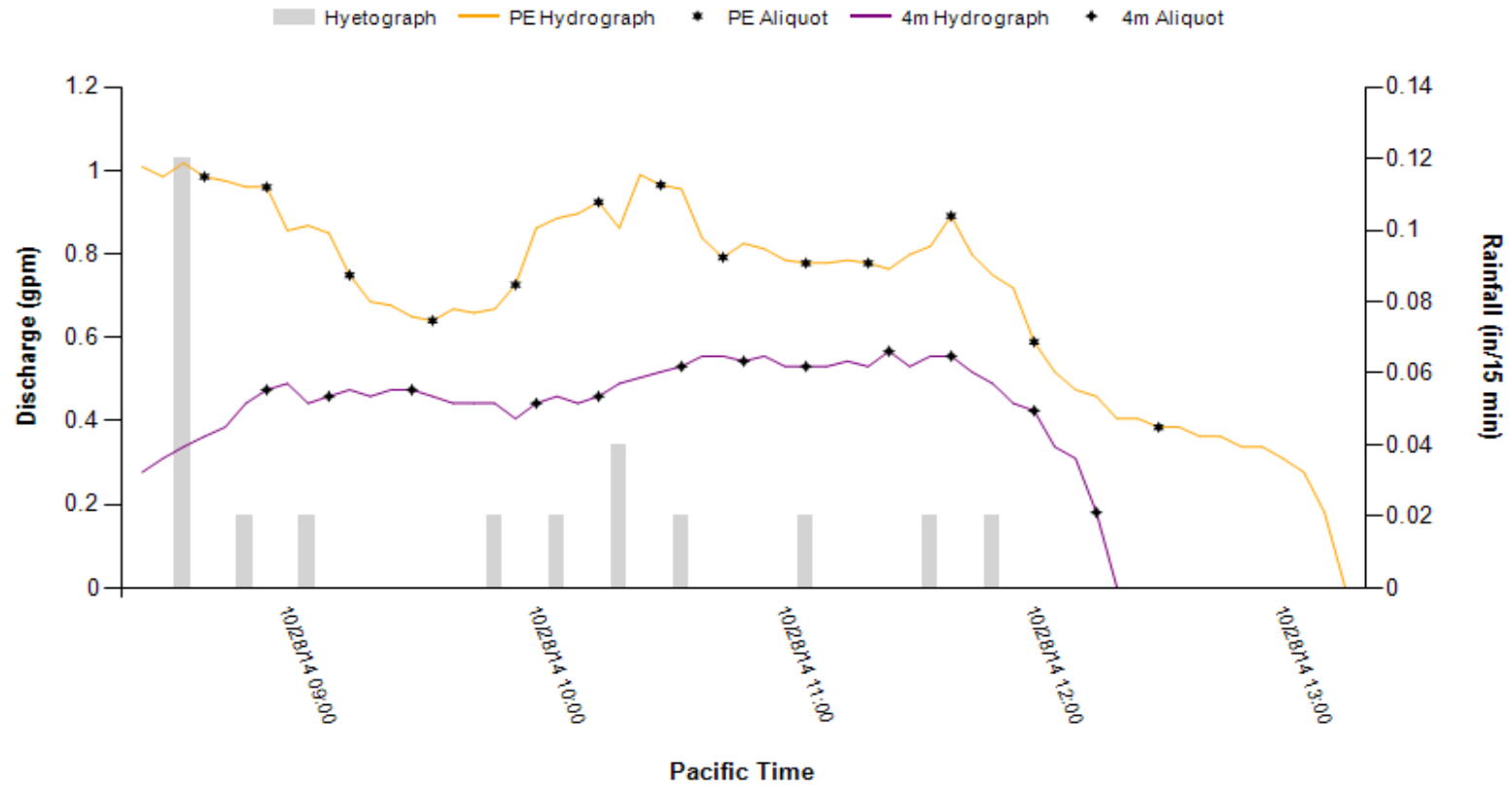


Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.97	10/13/2014 19:10		10/14/2014 04:00	8.83	52.66							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	20	10/13/2014 19:40	10/14/2014 04:25	8.75	250	5,000	11.90	15.60				
2	20	10/13/2014 21:10	10/14/2014 02:00	4.83	250	5,000	12.50	15.50	R			
4	20	10/13/2014 21:30	10/14/2014 02:40	5.17	250	5,000	12.10	15.40	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	10/13/2014 19:15	10/14/2014 04:50	9.58	480.5	50.2	480.5	446.98	93.30	1.49	0.18	0.86	0.231
2	10/13/2014 20:55	10/14/2014 04:10	7.25	170.4	23.5	170.4	133.0	78.07	0.64	0.18	0.39	0.026
4	10/13/2014 21:20	10/14/2014 08:45	11.42	259.7	22.7	259.7	104.9	40.39	0.69	0.18	0.38	0.031

R = Rejected because less than 75% of the hydrograph was sampled and beginning of storm not sampled.

Precipitation												
Total (in)		Start Time		End Time		Duration (hrs)	Antecedent (hrs)					
0.16		10/28/2014 08:25		10/28/2014 11:40		3.25	56					
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)		Max (C°)		
PE	13	10/28/2014 08:40		10/28/2014 12:30	3.83	250	3,250	9.70	11.70			
4	20	10/28/2014 08:55		10/28/2014 15:50	6.92	250	5,000	9.80	14.40			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	10/28/2014 08:25	10/28/2014 13:10	4.75	216.67	43.6	216.67	190.23	92.48	1.02	0.18	0.71	0.086
4	10/28/2014 08:25	10/28/2014 12:15	3.83	206.34	28.3	206.34	190.84	87.80	0.57	0.18	0.47	0.019

## Everett MVFS 10/28/2014 Storm Event



Precipitation												
Total (in)		Start Time		End Time		Duration (hrs)	Antecedent (hrs)					
0.33		12/18/2014 16:35		12/19/2014 00:10		7.58	14.58					
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)		Max (C°)		
PE	37	12/18/2014 18:30		12/18/2014 22:55	4.42	250	9,250	7.60	7.90	R		
2	23	12/18/2014 18:30		12/18/2014 23:15	4.75	250	5,750	7.50	7.90	R		
4	19	12/18/2014 22:15		12/18/2014 23:45	1.50	250	4,750	7.50	7.80	R		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	12/18/2014 16:35	12/19/2014 05:00	12.42	443.2	35.7	443.2	298.5	67.40	1.14	0.18	0.73	0.115
2	12/18/2014 16:45	12/19/2014 01:25	8.67	162.41	18.3	162.41	109.67	67.58	0.56	0.18	0.34	0.018
4	12/18/2014 18:35	12/19/2014 01:10	6.58	117.4	17.8	117.4	74.68	63.6	0.73	0.18	0.38	0.036

R = Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)		Start Time		End Time		Duration (hrs)	Antecedent (hrs)					
0.34		03/14/2015 00:40		03/14/2015 08:20		7.67	349.66					
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)		Max (C°)		
PE	9	03/14/2015 01:05		03/14/2015 03:55	2.83	250	2,250	11.70	12.10	J		
2	6	03/14/2015 02:05		03/14/2015 03:00	0.92	250	1,500	12.10	12.10	R		
4	12	03/14/2015 02:10		03/14/2015 03:05	0.92	250	3,000	12.00	12.10	R		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/14/2015 00:45	03/14/2015 08:00	7.25	242.1	33.4	242.1	179.5	74.15	1.29	0.18	0.60	0.158
2	03/14/2015 01:55	03/14/2015 03:40	1.75	42.1	24.0	42.1	30.1	71.60	0.60	0.18	0.38	0.022
4	03/14/2015 02:05	03/14/2015 03:30	1.42	39.7	28.0	39.7	32.8	82.60	0.56	0.18	0.44	0.018

J=Estimate of Hydrology information

R = Rejected because less than 75% of the hydrograph was sampled and beginning of storm not sampled.

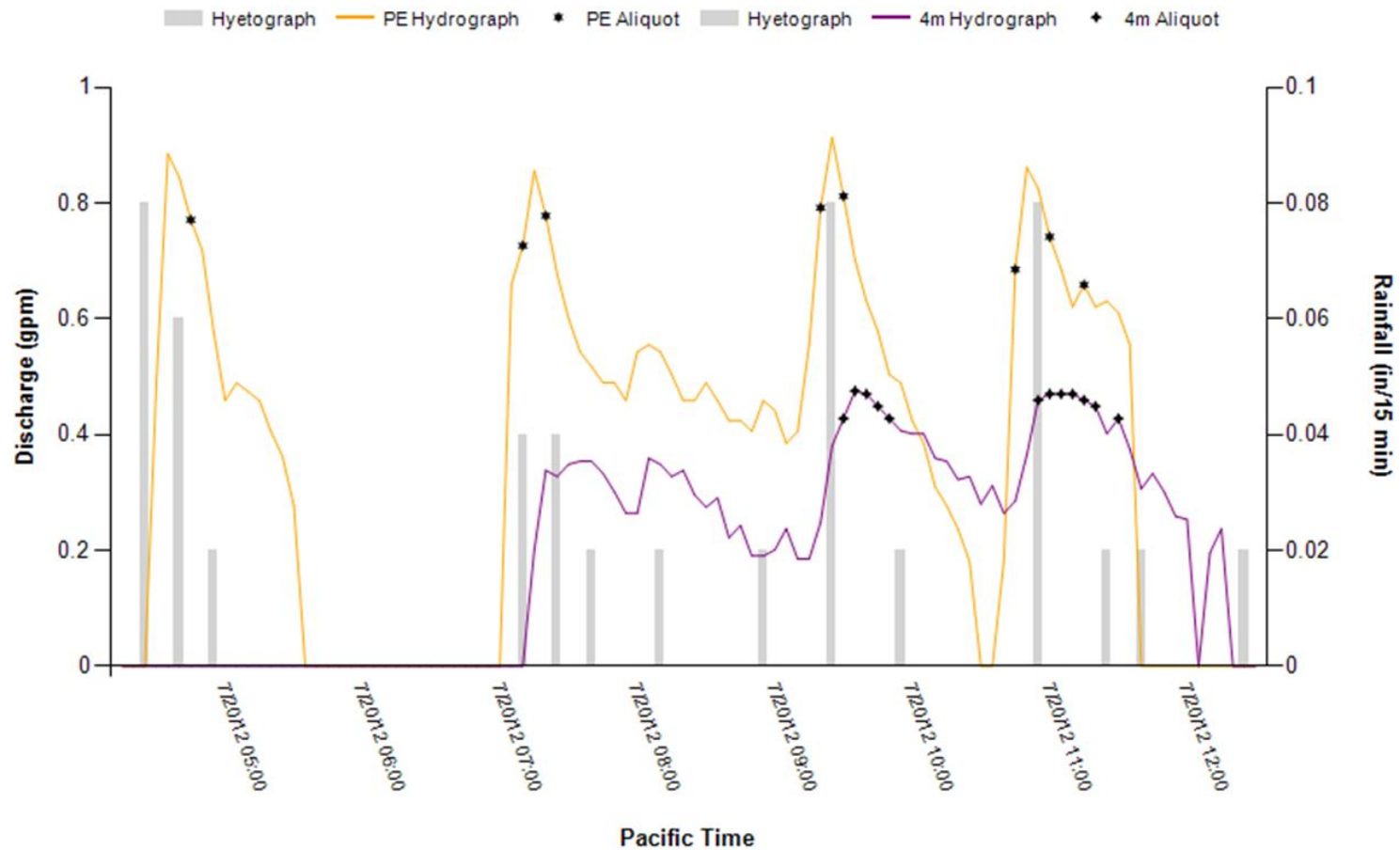
Precipitation												
Total (in)		Start Time		End Time		Duration (hrs)	Antecedent (hrs)					
0.36		08/29/2015 03:30		08/29/2015 07:50		4.33	185.49					
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)		Max (C°)		
PE	11	08/29/2015 04:15		08/29/2015 10:40	6.42	250	2,750	16.70	19.30			
2	6	08/29/2015 06:45		08/29/2015 09:05	2.33	250	1,500	16.70	17.50	R		
4	11	08/29/2015 06:45		08/29/2015 12:50	6.08	250	2,750	16.70	22.00	R		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	08/29/2015 03:35	08/29/2015 12:50	9.25	338.4	36.6	338.4	321.1	94.90	1.31	0.18	0.68	0.166
2	08/29/2015 06:25	08/29/2015 09:35	3.17	N/A	N/A	N/A	N/A	77.65	0.70	0.18	0.47	0.033
4	08/29/2015 06:30	08/29/2015 13:10	6.67	N/A	N/A	N/A	N/A	98.50	0.69	0.18	0.37	0.032

R = Rejected because beginning of storm was not sampled.

## Pilchuck VFS

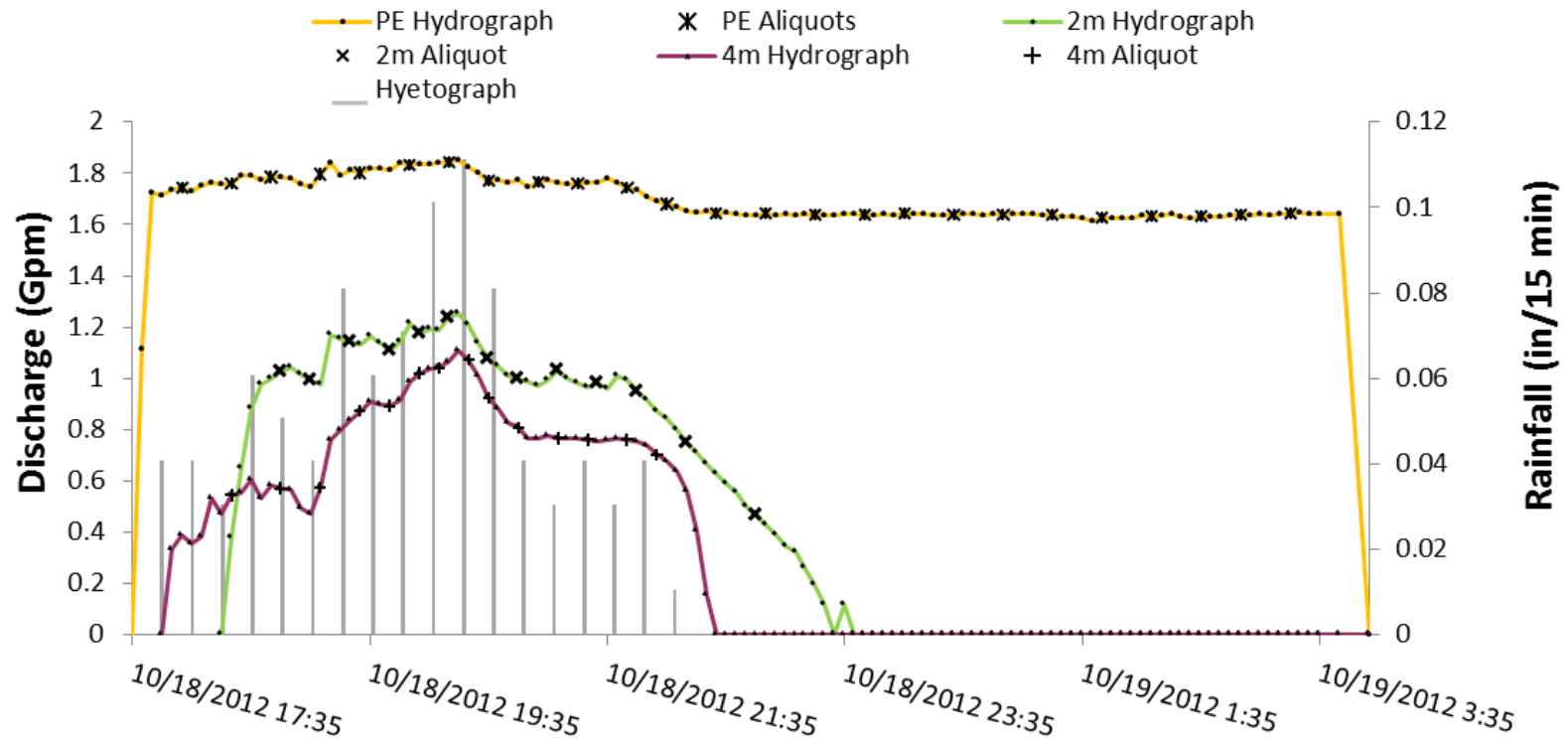
Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.27	07/20/2012 04:15		07/20/2012 12:20	8.08	67.24							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	8	07/20/2012 04:45	07/20/2012 11:15	6.50	250	2,000	16.48	17.59				
4	12	07/20/2012 09:30	07/20/2012 11:30	2.00	250	3,000	17.00	17.59				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	07/20/2012 04:30	07/20/2012 11:35	7.08	182.2	25.7	182.2	170.1	93.40	0.91	0.18	0.55	0.065
4	07/20/2012 07:15	07/20/2012 12:15	5.00	99.0	19.8	99.0	87.7	88.60	0.48	0.18	0.33	0.012

## Pilchuck VFS 7/20/2012 Storm Event



Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.95	10/18/2012 17:35		10/18/2012 21:50		4.25	62.74						
Aliquots								Water Temp		Validation Code		
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)			
PE	25	10/18/2012 18:00		10/19/2012 3:20		9.33	250	6,250	11.25	12.98		
2	13	10/18/2012 18:50		10/19/2012 22:50		4.00	250	3,250	11.25	11.79		
4	14	10/18/2012 18:25		10/18/2012 22:00		3.58	250	3,500	11.31	11.79		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	10/18/2012 17:40	10/19/2012 3:45	10.08	1,025.60	101.75	1,025.60	992.71	96.79	1.85	1.11	1.70	0.119
2	10/18/2012 18:25	10/18/2012 23:35	5.17	270.51	52.32	270.51	259.65	95.99	1.25	0.12	0.55	0.147
4	10/18/2012 17:55	10/18/2012 22:25	4.50	198.34	44.08	198.34	186.16	93.86	1.11	0.15	0.46	0.107

### Pilchuck VFS 10/18/2012 Storm Event



Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.15	11/7/2012 0:35		11/7/2012 3:25	2.83	49.5							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	9	11/7/2012 0:55	11/7/2012 2:25	1.50	250	2,250	9.18	10.56	J			
4	9	11/7/2012 0:50	11/7/2012 2:05	1.25	250	2,250	9.24	10.56	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	11/7/2012 0:45	11/7/2012 2:30	1.75	74.84	42.77	74.84	72.73	97.18	1.04	0.31	0.75	0.091
4	11/7/2012 0:40	11/7/2012 2:20	1.67	38.81	23.24	38.81	34.37	88.56	0.52	0.18	0.37	0.015

J=Estimate of Hydrology information

R = Data is not reliable.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.62	12/11/2012 9:35		12/12/2012 11:30	25.92	37.25							
Aliquots							Water Temp		Validation code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	N/A	N/A	N/A	N/A	N/A	N/A	5.18	6.54				
4	37	12/11/2012 13:55	12/12/2012 11:35	21.67	250	9,250	4.40	6.34				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	12/11/2012 9:45	12/12/2012 12:40	26.92	779.94	28.97	708.09	N/A	N/A	0.97	0.08	0.52	0.076
4	12/11/2012 10:15	12/12/2012 15:20	29.08	472.34	16.24	417.87	417.87	100.00	0.76	0.07	0.33	0.040

Only grab samples collected at influent.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.16	2/21/2013 2:25		2/21/2013 18:50	16.42	37.99							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	8	2/21/2013 7:40	2/21/2013 19:20	11.67	250	2,000	3.72	5.88	J			
4	22	02/21/2013 11:20	02/22/2013 05:30	18.17	250	5,500	3.43	5.88	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	2/21/2013 2:30	2/21/2013 21:30	19.00	351.43	18.50	351.43	317.09	90.23	0.71	0.04	0.39	0.035
4	02/21/2013 10:30	02/22/2013 05:15	18.75	540.46	18.61	540.46	535.64	99.10	0.72	0.18	0.41	0.022

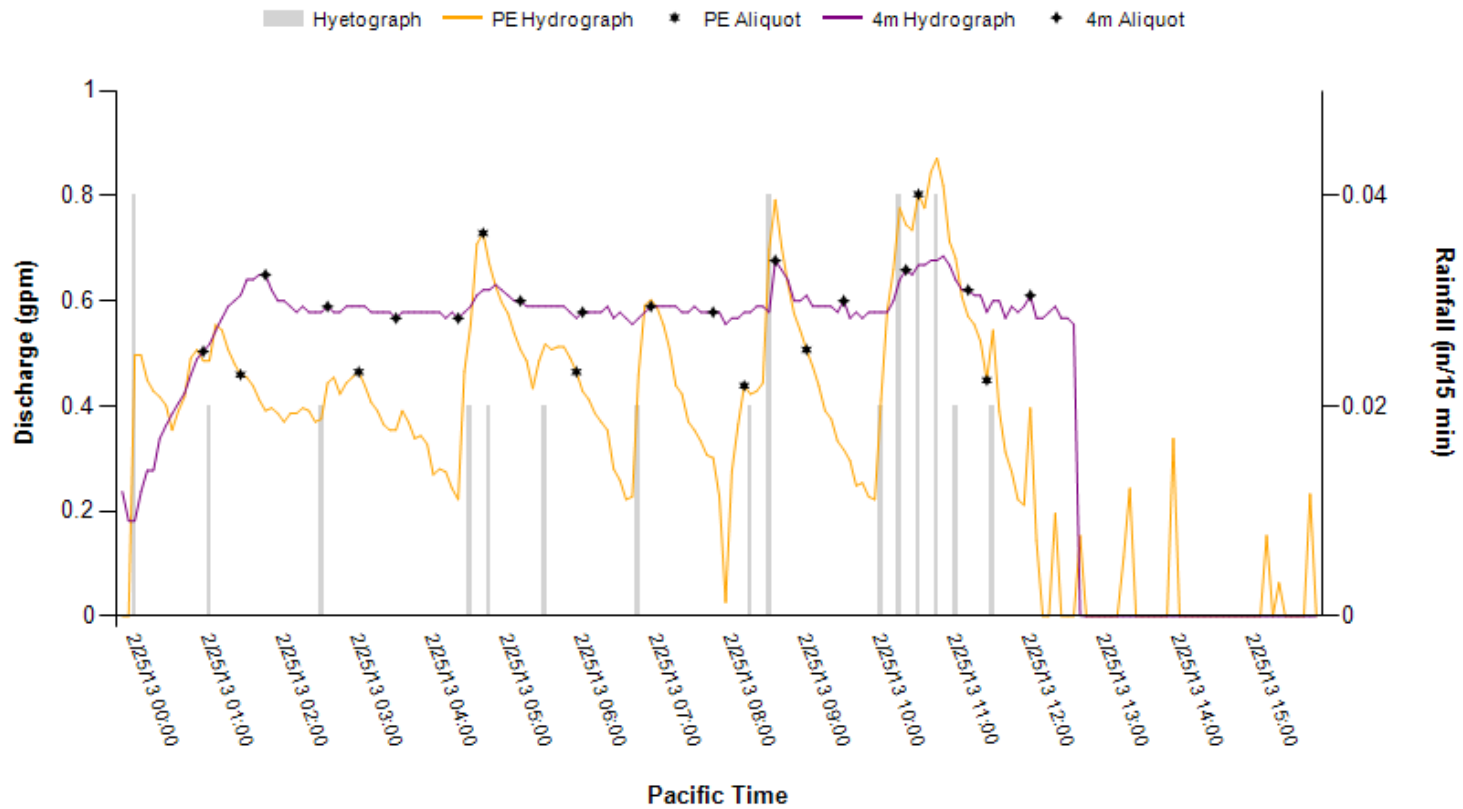
J=Estimate of Hydrology information

R = Data is not reliable.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.20	2/24/2013 23:50		2/25/2013 11:25	11.58	38							
Aliquots							Water Temp		Validation code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	8	2/25/2013 1:25	2/25/2013 11:25	10.00	250	2,000	4.74	5.21	J			
4	19	2/25/2013 0:55	2/25/2013 16:20	15.42	250	4,750	4.74	8.57	J			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	2/25/2013 0:00	2/25/2013 15:45	15.75	337.45	21.43	337.45	317.53	94.10	0.87	0.03	0.44	0.057
4	2/24/2013 23:55	2/25/2013 16:45	16.83	774.13	46.00	774.13	755.29	97.57	0.84	0.60	0.76	0.052

J=Estimate of Hydrology information

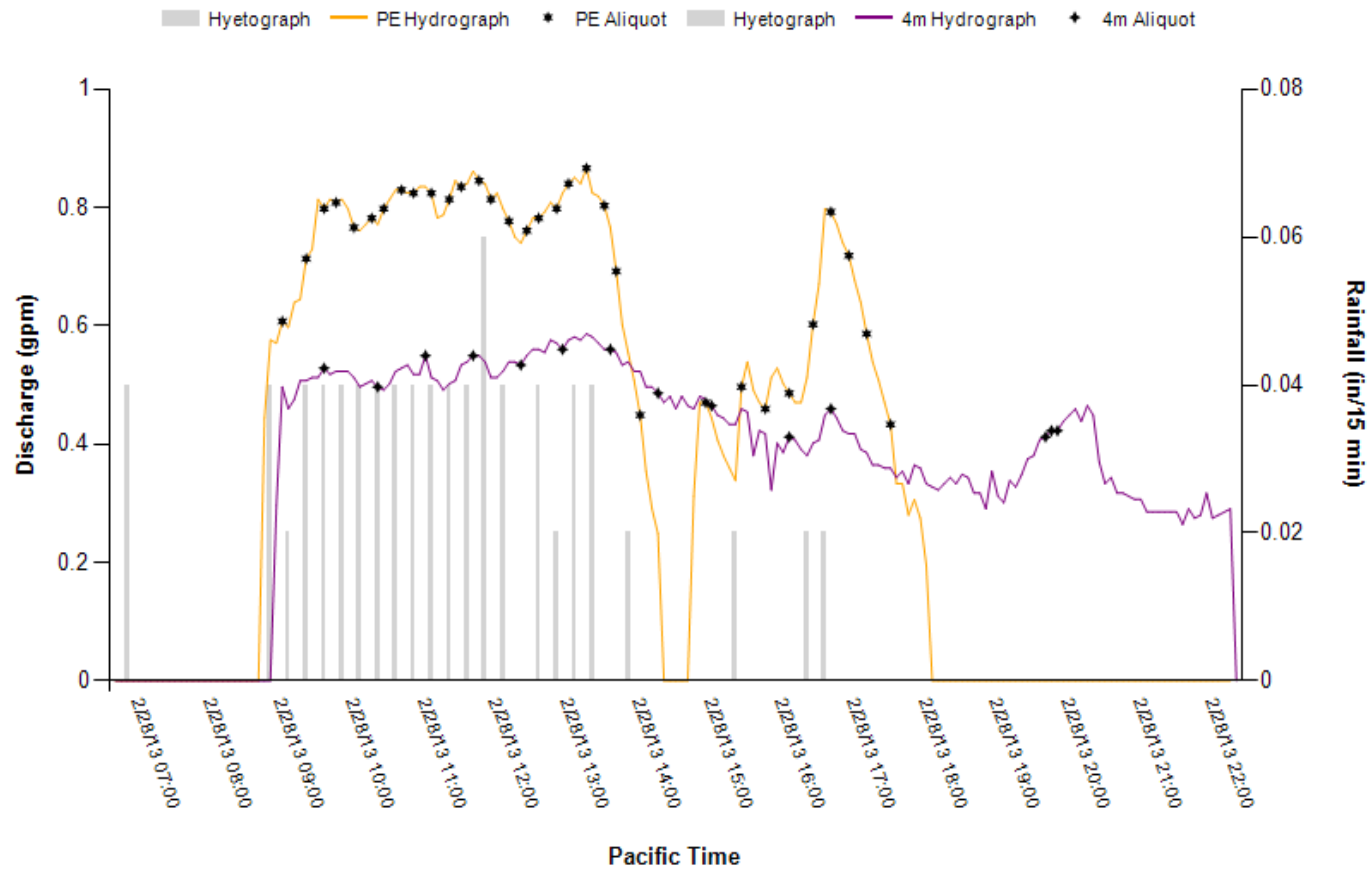
## Pilchuck VFS 2/25/2013 Storm Event



Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.41	2/28/2013 6:40		2/28/2013 16:35		9.92	67.75						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)			Min (C°)	Max (C°)
PE	32	2/28/2013 9:00		2/28/2013 17:30		8.50	250	8,000	5.46	7.77		
2	9	2/28/2013 11:45		2/28/2013 13:30		1.75	250	2,250	7.01	7.71	R	
4	14	2/28/2013 9:35		2/28/2013 19:50		10.25	250	3,500	5.87	8.22		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	02/28/2013 16:45	2/28/2013 18:00	9.25	347.12	37.53	347.12	338.51	97.52	0.87	0.20	0.65	0.057
2	2/28/2013 11:00	2/28/2013 22:15	11.25	55.08	4.90	55.08	43.51	78.99	0.50	0.07	0.35	0.014
4	2/28/2013 8:55	2/28/2013 22:15	13.33	348.26	26.13	348.26	301.82	86.66	0.59	0.26	0.44	0.021

R = Data is not reliable.

## Pilchuck VFS 2/28/2013 Storm Event



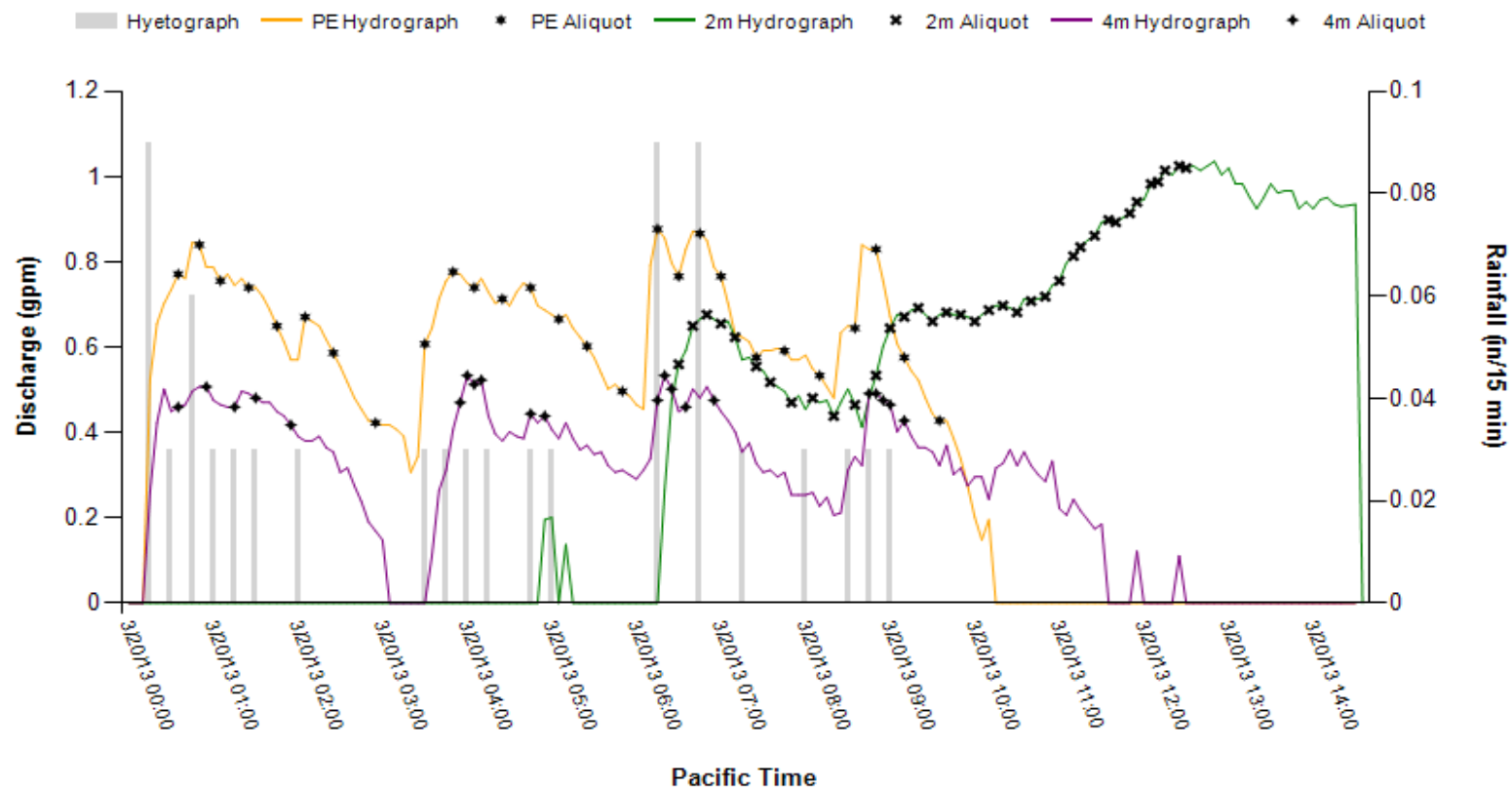
Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.33	3/2/2013 14:40		3/2/2013 18:30	3.83	46.24							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	10	3/2/2013 15:05	3/2/2013 17:55	2.83	250	2,500	6.85	9.20				
2	19	3/2/2013 15:35	3/2/2013 17:05	1.50	250	4,750	7.17	8.65	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/2/2013 14:45	3/2/2013 18:20	3.58	182.60	51.00	182.60	171.92	94.16	0.98	0.20	0.83	0.079
2	3/2/2013 14:45	3/2/2013 17:10	2.42	57.09	23.59	57.09	55.87	97.87	0.63	0.18	0.50	0.025

R = Data is not reliable.

Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.27	3/20/2013 0:10		3/20/2013 8:50		8.83	41.74						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	27	3/20/2013 0:35	3/20/2013 9:35	9.00	250	6,750	6.64	8.99				
2	37	3/20/2013 6:30	3/20/2013 12:30	6.00	250	9,250	7.98	11.68	J			
4	21	3/20/2013 0:35	3/20/2013 9:10	8.58	250	5,250	6.64	8.72				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/20/2013 0:15	3/20/2013 10:10	9.92	373.70	37.67	373.70	363.84	97.36	0.88	0.15	0.62	0.059
2	3/20/2013 4:55	3/20/2013 14:30	9.58	368.12	38.43	368.12	256.72	69.74	1.04	0.14	0.73	0.090
4	3/20/2013 0:15	3/20/2013 12:25	12.17	238.34	19.58	238.34	195.88	82.19	0.53	0.11	0.30	0.016

J=Estimate of Hydrology information

## Pilchuck VFS 3/20/2013 Storm Event



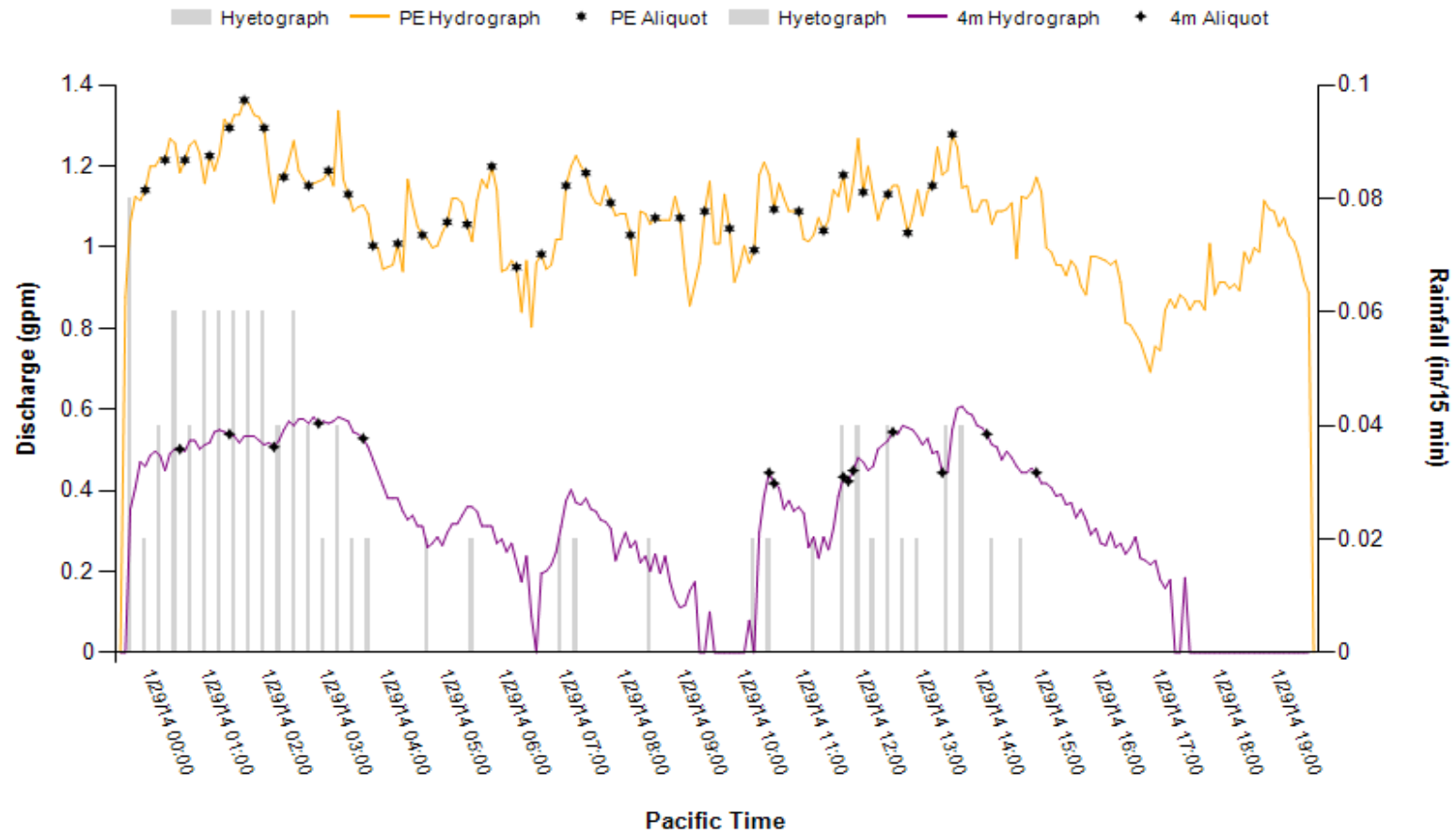
Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.97	01/07/2014 03:20		01/07/2014 20:35	17.25	79.75							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	29	01/07/2014 04:30	01/08/2014 00:15	19.75	250	7,250	2.07	6.54				
2	37	01/07/2014 08:50	01/07/2014 21:00	12.17	250	9,250	3.81	6.54	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/07/2014 03:25	01/08/2014 02:15	22.83	964.6	42.3	964.6	920.2	95.40	1.13	0.23	0.73	0.111
2	01/07/2014 08:20	01/08/2014 02:15	17.92	N/A	N/A	N/A	N/A	57.60	0.97	0.28	0.58	0.076

R = Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.62	01/28/2014 23:30		01/29/2014 14:40		15.17	373.24						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)			Min (C°)	Max (C°)
PE	37	01/28/2014 23:55		01/29/2014 13:30		13.58	250	9,250	5.82	8.87	J	
4	14	01/29/2014 00:30		01/29/2014 14:55		14.42	250	3,500	5.82	9.14		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/28/2014 23:35	01/29/2014 19:30	19.92	1,280.3	64.3	1,280.3	931.5	72.80	1.36	0.69	1.07	0.181
4	01/28/2014 23:40	01/29/2014 17:25	17.75	392.1	22.1	392.1	351.5	89.70	0.61	0.08	0.39	0.023

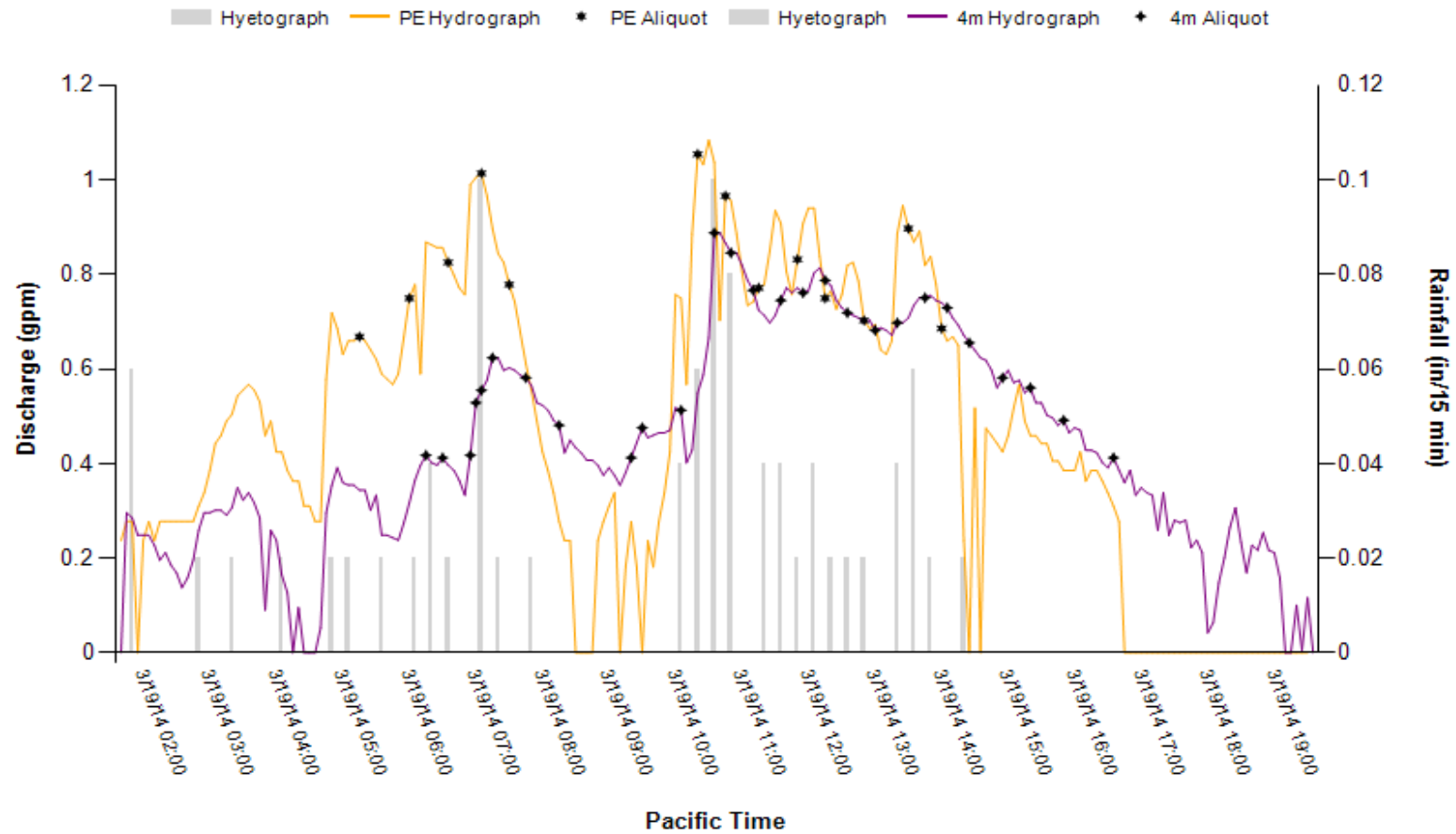
J=Estimate of Hydrology information

## Pilchuck VFS 1/28/2014 Storm Event



Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.51	03/19/2014 01:40		03/19/2014 14:15		12.58	40						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)		Min (C°)	Max (C°)	
PE	13	03/19/2014 05:15		03/19/2014 14:00		8.75	250	3,250	7.28	8.92		
4	27	03/19/2014 06:15		03/19/2014 16:35		10.33	250	6,750	7.28	8.92		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/19/2014 01:40	03/19/2014 16:40	15.00	502.3	33.5	502.3	436.4	86.90	1.08	0.18	0.59	0.101
4	03/19/2014 01:45	03/19/2014 19:30	17.75	470.5	26.5	470.5	431.7	91.70	0.89	0.01	0.45	0.061

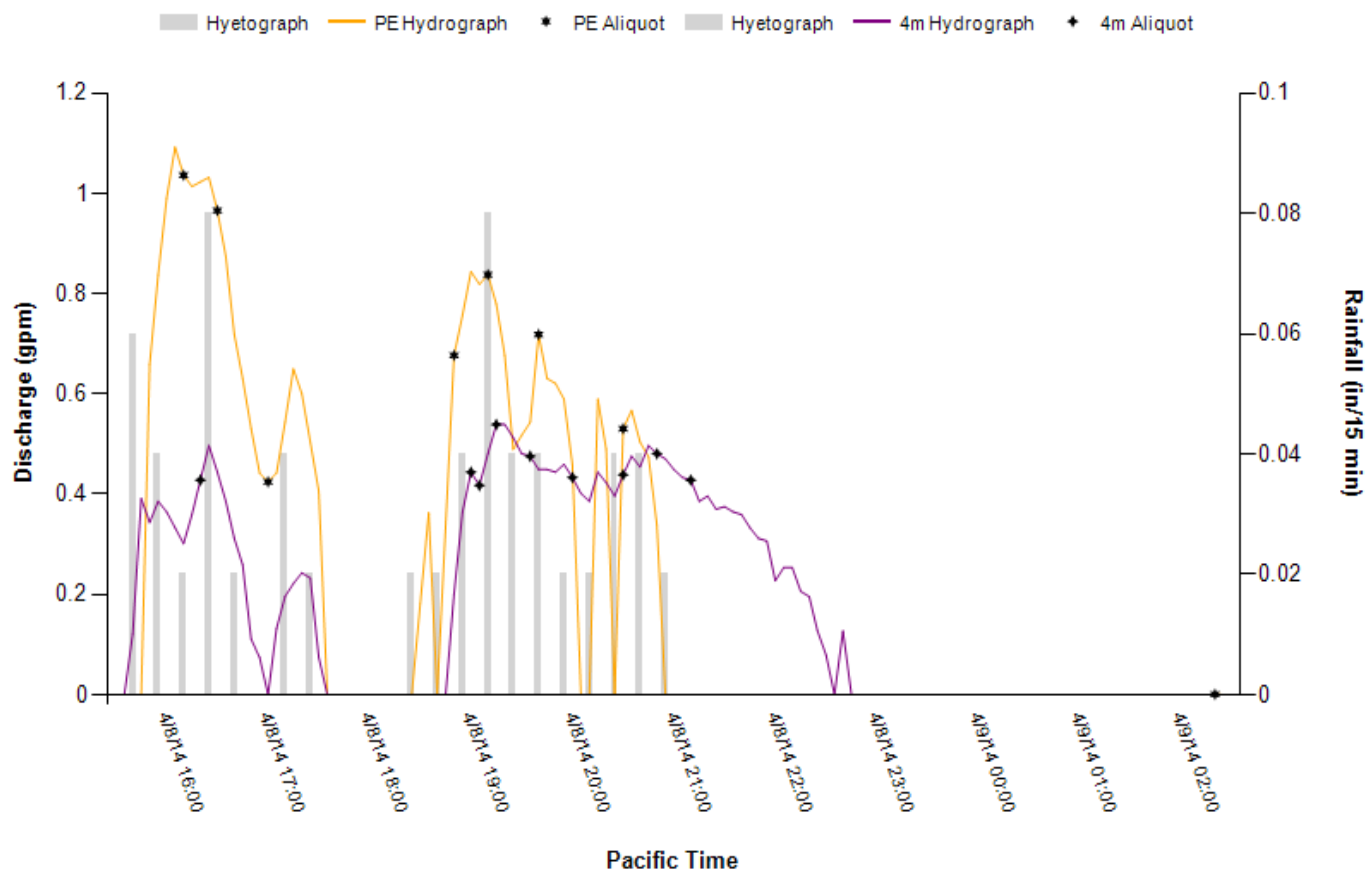
## Pilchuck VFS 3/19/2014 Storm Event



Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.33	04/08/2014 15:30		04/08/2014 20:55	5.42	57.49							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	12	04/08/2014 16:10	04/09/2014 02:20	10.17	250	3,000	6.39	13.78	J			
4	9	04/08/2014 16:20	04/08/2014 21:10	4.83	250	2,250	9.71	13.42				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/08/2014 15:50	04/09/2014 02:20	10.50	148.7	14.2	148.7	148.7	100.00	1.09	0.00	0.63	0.103
4	04/08/2014 15:40	04/08/2014 22:40	7.00	118.7	17.0	118.7	95.4	80.30	0.54	0.07	0.35	0.017

J=Estimate of Hydrology information

## Pilchuck VFS 4/8/2014 Storm Event



Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.96	06/12/2014 21:35		06/13/2014 11:35		14.00	352.24						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)			Min (C°)	Max (C°)
PE	26	06/12/2014 21:55		06/13/2014 11:35		13.67	250	6,500	12.60	14.90	R	
4	31	06/12/2014 21:50		06/13/2014 08:00		10.17	250	7,750	12.60	15.50		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	06/12/2014 21:40	06/13/2014 12:40	15.00	539.4	36.0	539.4	340.68	63.20	1.24	0.18	0.66	0.144
4	06/12/2014 21:40	06/13/2014 12:00	14.33	325.2	22.7	325.2	288.7	88.80	0.90	0.18	0.49	0.062

R = Rejected because less than 75% of the hydrograph was sampled.

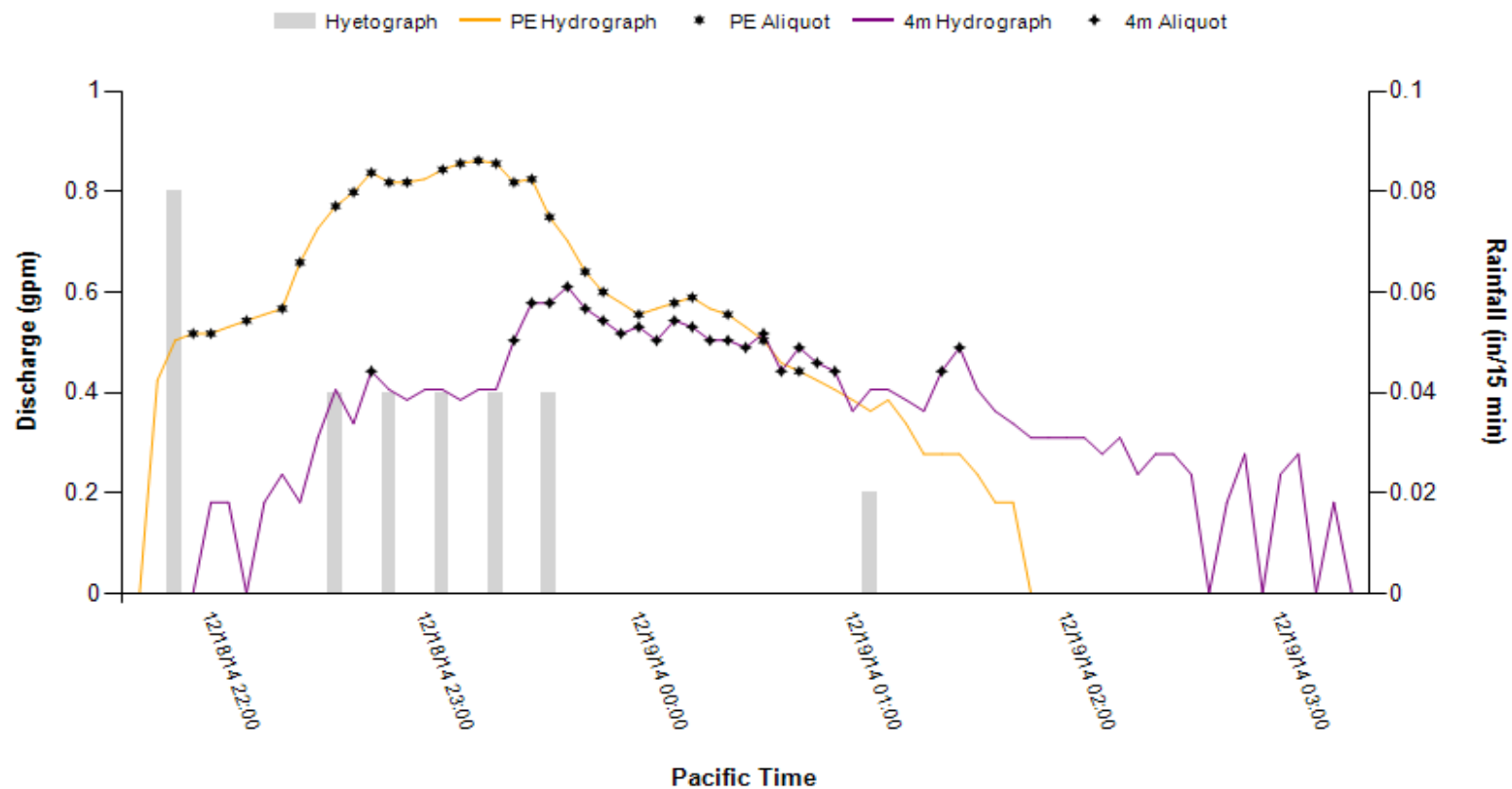
Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.21	11/05/2014 22:55		11/06/2014 02:35	3.67	36							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	11	11/05/2014 23:15	11/06/2014 03:00	3.75	250	2,750	12.80	12.90				
2	13	11/06/2014 00:25	11/06/2014 01:25	1.00	250	3,250	12.90	12.90	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	11/05/2014 23:00	11/06/2014 05:40	6.67	195.7	29.3	195.7	160.7	82.10	1.05	0.18	0.51	0.092
2	11/05/2014 23:00	11/06/2014 03:00	4.00	N/A	N/A	N/A	N/A	47.33	0.83	0.18	0.37	0.051

R = Rejected because less than 75% of the hydrograph was sampled and beginning of storm was not sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.15	12/18/2014 21:40		12/19/2014 01:05	3.42	17.33							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	25	12/18/2014 21:55	12/19/2014 00:45	2.83	250	6,250	8.30	8.40				
4	22	12/18/2014 22:45	12/19/2014 01:30	2.75	250	5,500	8.30	8.40	J			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	12/18/2014 21:45	12/19/2014 01:45	4.00	139.1	34.8	139.1	120.5	86.60	0.86	0.18	0.57	0.056
4	12/18/2014 22:00	12/19/2014 03:15	5.25	115.4	22.0	115.4	89.8	77.80	0.61	0.18	0.38	0.023

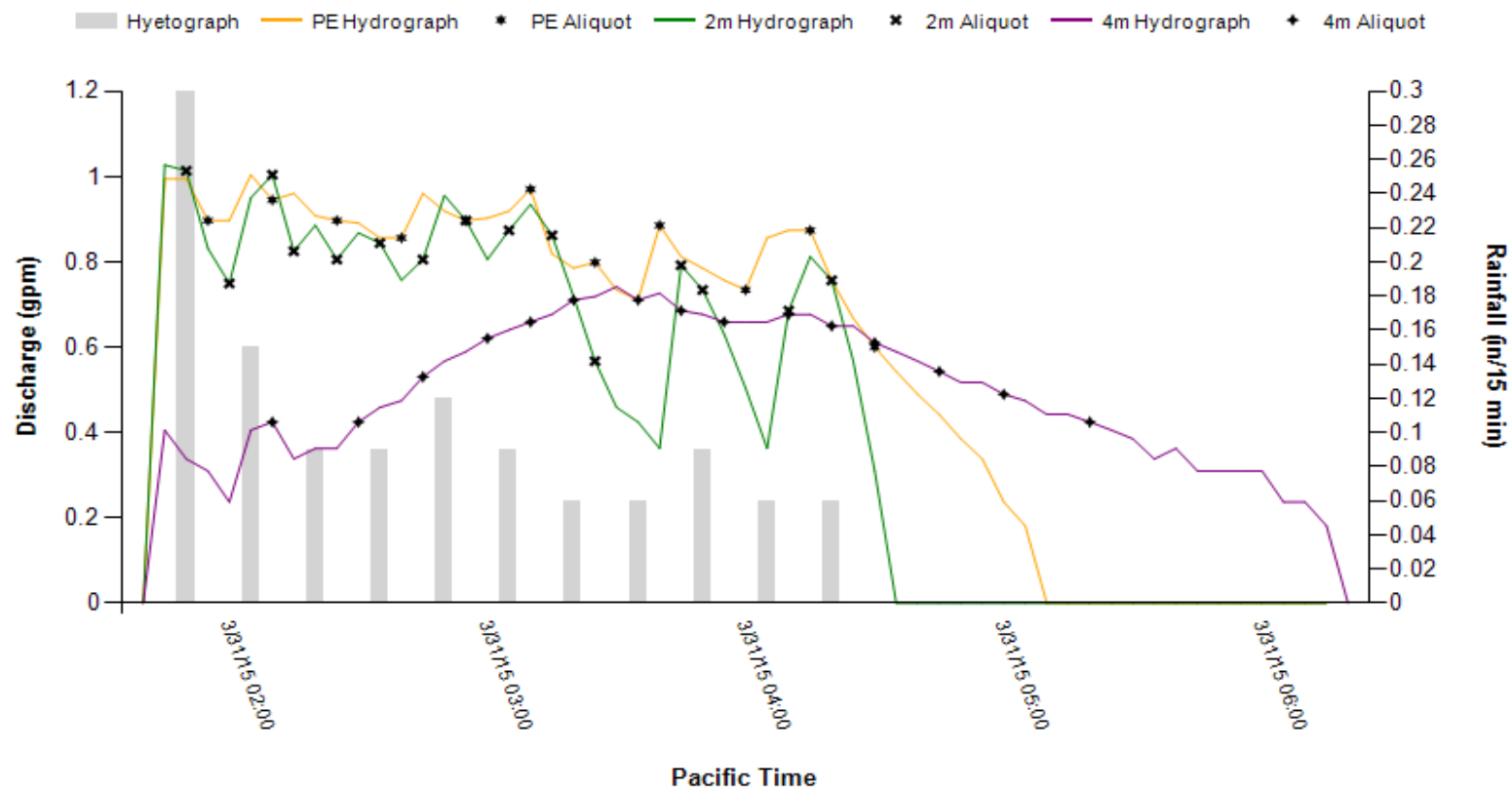
J=Estimate of Hydrology information

## Pilchuck VFS 12/19/2014 Storm Event



Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.39	03/31/2015 01:40		03/31/2015 04:15		2.58	40.25						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	11	03/31/2015 01:55	03/31/2015 04:30	2.58	250	2,750	8.80	11.20				
2	15	03/31/2015 01:50	03/31/2015 04:20	2.50	250	3,750	8.90	11.30				
4	15	03/31/2015 02:10	03/31/2015 05:20	3.17	250	3,750	8.50	10.70				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/31/2015 01:45	03/31/2015 05:05	3.33	158.7	47.7	158.7	145.6	91.80	1.00	0.18	0.77	0.090
2	03/31/2015 01:45	03/31/2015 04:30	2.75	126.9	46.1	126.9	122.5	96.50	1.03	0.31	0.75	0.088
4	03/31/2015 01:45	03/31/2015 06:15	4.50	137.1	30.5	137.1	120.2	87.70	0.74	0.18	0.50	0.038

## Pilchuck VFS 3/31/2015 Storm Event



Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.36	04/10/2015 22:20		04/11/2015 02:25		4.08	173.16						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	7	04/10/2015 23:20	04/11/2015 00:50	1.50	250	1,750	8.40	9.00	R			
2	9	04/10/2015 23:30	04/11/2015 00:45	1.25	250	2,250	8.50	9.00	J			
4	10	04/10/2015 23:15	04/11/2015 01:20	2.08	250	2,500	8.10	9.00	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/10/2015 23:05	04/11/2015 01:20	2.25	105.9	47.1	105.9	94.3	89.00	1.07	0.18	0.76	0.098
2	04/10/2015 23:20	04/11/2015 01:30	2.17	82.2	37.9	82.2	71.8	87.40	1.06	0.18	0.63	0.096
4	04/10/2015 22:55	04/11/2015 04:10	5.25	118.5	22.6	118.5	80.7	68.20	0.69	0.18	0.41	0.032

J=Estimate of Hydrology information

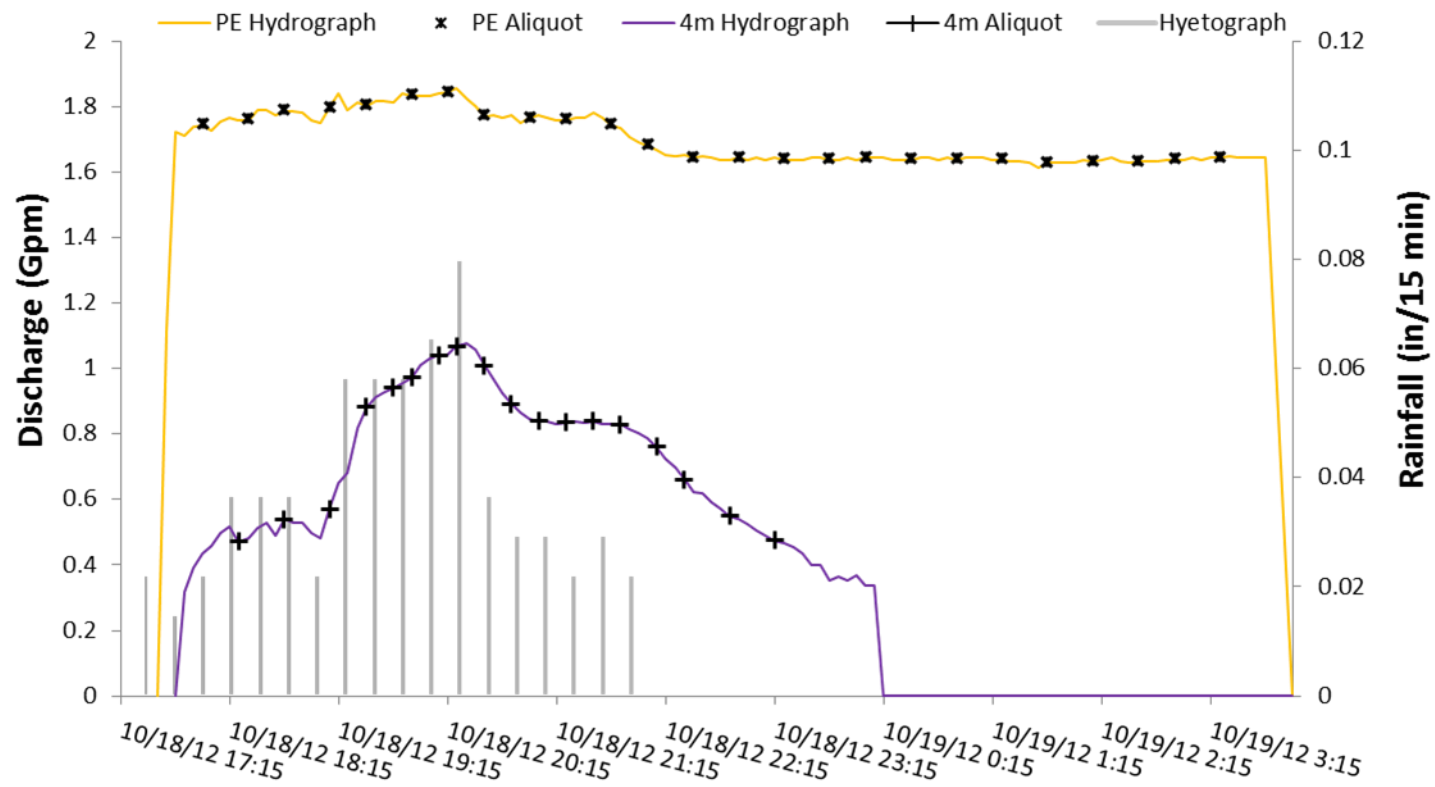
R = Rejected because of inadequate aliquot numbers and beginning of storm not sampled.

## Pilchuck CAVFS

Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.93	10/18/2012 17:25		10/18/2012 21:50		4.42	63.25						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)			Min (C°)	Max (C°)
PE	25	10/18/2012 18:00		10/19/2012 3:20		9.33	250	6,250	11.25	12.98		
4	18	10/18/2012 18:20		10/18/2012 23:15		4.92	250	4,500	11.07	11.58	J	
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	10/18/2012 17:40	10/19/2012 3:45	10.08	1,025.60	101.75	1,025.60	992.71	96.79	1.85	1.11	1.70	0.119
4	10/18/2012 17:50	10/19/2012 0:15	6.42	266.92	41.58	266.92	239.50	89.73	1.21	0.32	0.68	0.099

J=Estimate of Hydrology information

### Pilchuck CAVFS 10/18/2012 Storm Event

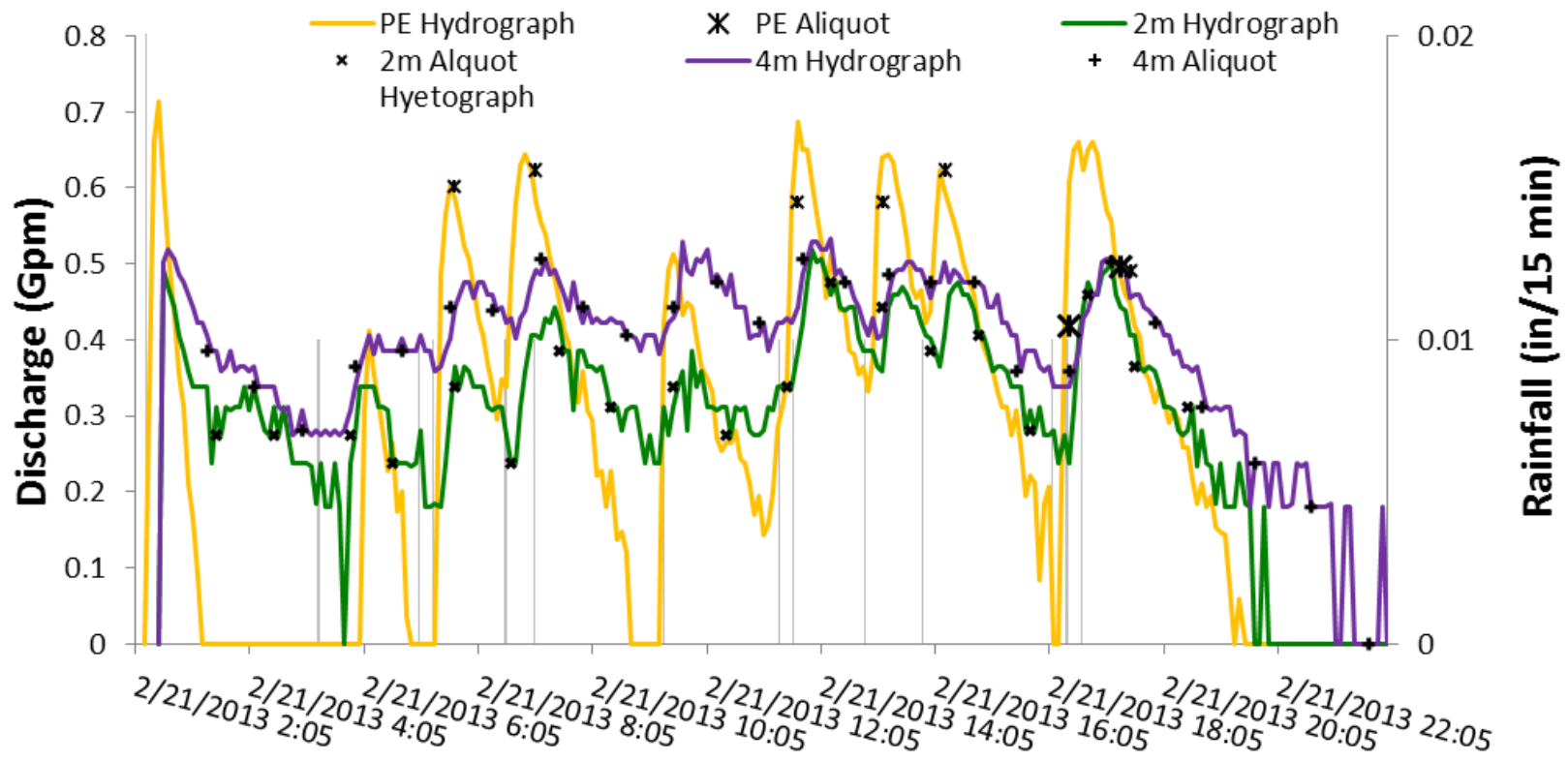


Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.16	2/21/2013 2:30		2/21/2013 18:55		16.42	37.5						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)		Min (C°)	Max (C°)	
PE	8	2/21/2013 7:40		2/21/2013 19:20		11.67	250	2,000	3.72	5.88		
2	19	2/21/2013 3:30		2/21/2013 20:30		17.00	250	4,750	3.32	6.01	R	
4	26	2/21/2013 3:20		2/21/2013 23:40		20.33	250	6,500	3.32	6.01	J	
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	2/21/2013 2:30	2/21/2013 21:30	19.00	351.43	18.50	351.43	317.09	90.23	0.71	0.04	0.39	0.035
2	2/21/2013 02:30	2/21/2013 21:45	19.25	382.6	19.9	382.6	369.0	96.40	0.52	0.18	0.33	0.015
4	2/21/2013 02:30	2/21/2013 23:50	21.33	496.8	23.3	496.8	495.9	99.80	0.53	0.18	0.40	0.016

J=Estimate of Hydrology information

R = Rejected because beginning of storm was not sampled.

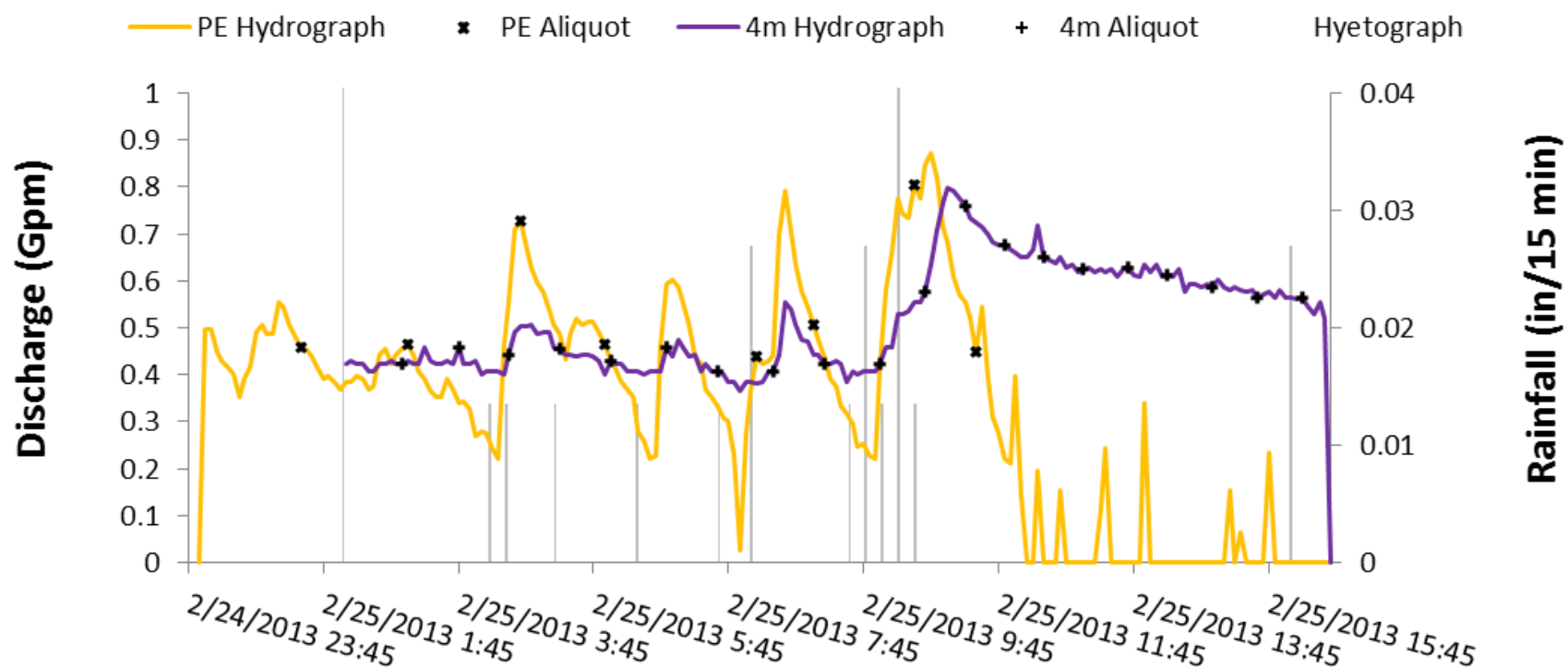
### Pilchuck CAVFS 2/21/2013 Storm Event



Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.18	2/25/2013 2:05		2/25/2013 10:55	8.83	40.25							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	8	2/25/2013 1:25	2/25/2013 11:25	10.00	250	2,000	4.74	5.21	J			
4	21	2/25/2013 2:55	2/25/2013 16:15	13.33	250	5,000	4.69	10.49	J			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	2/25/2013 0:00	2/25/2013 15:45	15.75	337.45	21.43	337.45	317.53	94.10	0.87	0.03	0.44	0.057
4	2/25/2013 2:10	2/25/2013 16:45	14.58	546.44	37.48	546.44	530.54	97.09	0.86	0.52	0.62	0.055

J=Estimate of Hydrology information

## Pilchuck CAVFS 2/25/2013 Storm Event



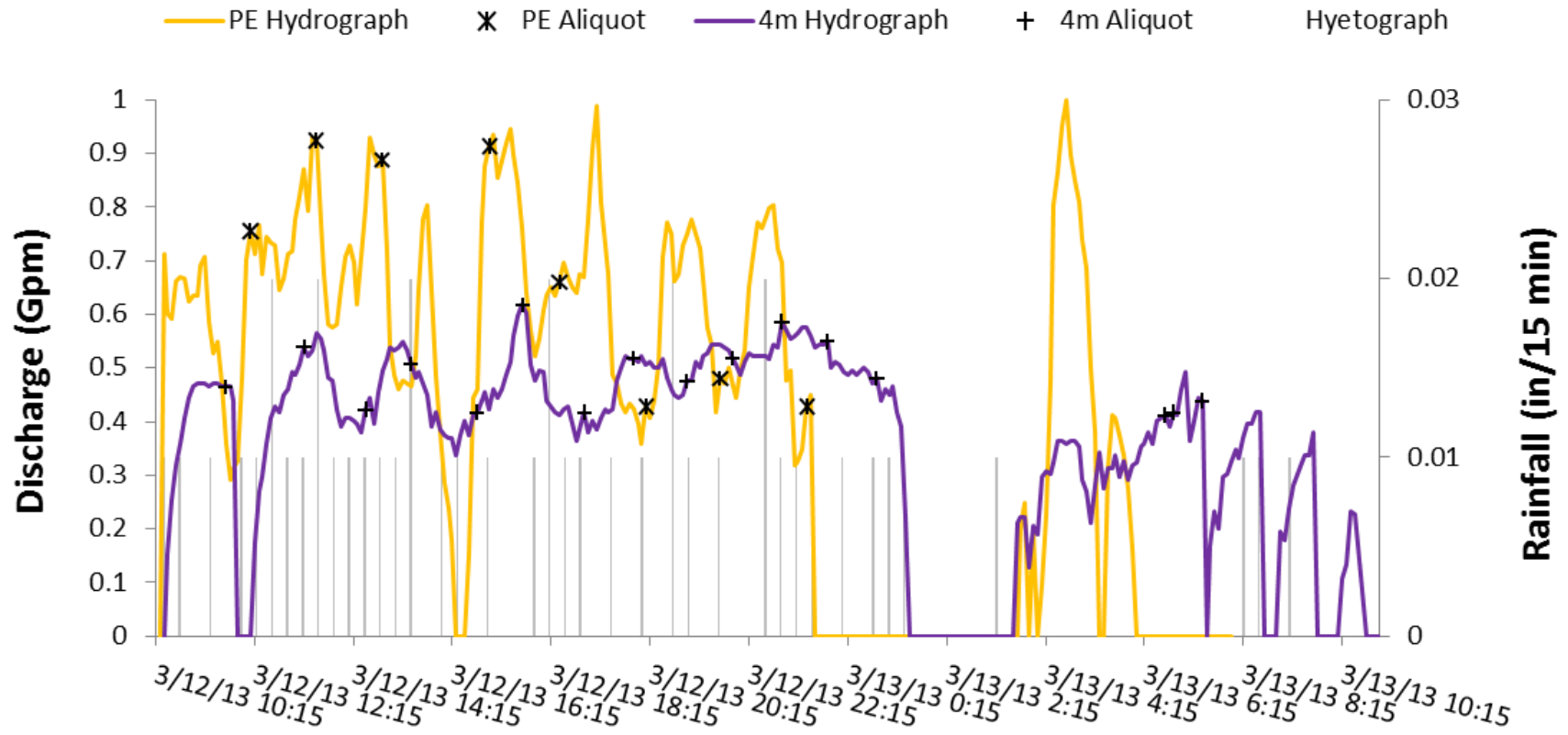
Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.39	2/28/2013 7:10		2/28/2013 17:10	10.00	68.25							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	32	2/28/2013 9:00	2/28/2013 17:30	8.50	250	8,000	5.46	7.77				
2	17	2/28/2013 8:45	2/28/2013 18:25	9.67	250	4,250	5.10	7.94	J			
4	21	2/28/2013 10:30	2/28/2013 21:35	11.08	250	5,250	5.83	9.45				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	02/28/2013 16:45	2/28/2013 18:00	9.25	347.12	37.53	347.12	338.51	97.52	0.87	0.20	0.65	0.057
2	2/28/2013 7:15	2/28/2013 21:45	14.50	439.48	30.31	439.48	359.99	72.00	0.70	0.26	0.50	0.033
4	2/28/2013 7:15	2/28/2013 21:45	14.50	451.15	31.11	451.15	445.76	98.81	0.77	0.17	0.53	0.041

J=Estimate of Hydrology information

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.48	3/12/2013 10:15		3/13/2013 5:05	18.83	117.24							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	8	3/12/2013 12:10	3/12/2013 23:25	11.25	250	2,000	9.85	10.54	J			
4	15	3/12/2013 11:40	3/13/2013 7:25	19.75	250	4,000	9.91	10.75				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/12/2013 10:25	3/13/2013 6:00	19.58	549.61	28.07	549.61	486.31	88.48	1.00	0.10	0.61	0.082
4	3/12/2013 10:30	3/13/2013 10:30	24.00	524.06	21.84	520.58	486.68	93.49	0.62	0.11	0.42	0.024

J=Estimate of Hydrology information

### Pilchuck CAVS 3/12/2013 Storm Event



Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.26	3/20/2013 0:15		3/20/2013 9:15	9.00	42							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	27	3/20/2013 0:35	3/20/2013 9:35	9.00	250	6,750	6.64	8.99				
4	21	3/20/2013 0:50	3/20/2013 14:25	13.58	250	7,000	6.42	14.74	J			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/20/2013 0:15	3/20/2013 10:10	9.92	373.70	37.67	373.70	363.84	97.36	0.88	0.15	0.62	0.059
4	3/20/2013 0:20	3/20/2013 14:45	14.42	598.85	41.53	598.85	591.80	73.8	0.88	0.46	0.70	0.059

J=Estimate of Hydrology information

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.33	4/12/2013 14:05		4/12/2013 22:40	8.58	48.25							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	17	04/12/2013 14:25	04/12/2013 22:55	8.50	250	4,250	5.81	7.24				
4	29	4/12/2013 15:55	4/12/2013 23:40	7.75	250	9,250	5.27	6.59	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/12/2013 14:00	04/12/2013 23:20	9.33	279.63	29.97	279.63	270.04	96.57	1.00	0.14	0.62	0.081
4	4/12/2013 14:15	4/13/2013 1:10	10.92	339.99	31.13	339.99	295.58	68.3	0.76	0.09	0.54	0.041

R = Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.99	01/07/2014 03:15		01/07/2014 23:40	20.42	79.5							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	29	01/07/2014 04:30	01/08/2014 00:15	19.75	250	7,250	2.07	6.54				
4	34	01/07/2014 09:30	01/07/2014 22:05	12.58	250	8,500	3.82	6.76	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/07/2014 03:25	01/08/2014 02:15	22.83	964.6	42.3	964.6	920.2	95.40	1.13	0.23	0.73	0.111
4	01/07/2014 03:15	01/08/2014 02:10	22.92	907.2	39.6	907.2	597.50	65.86	0.94	0.31	0.66	0.070

R = Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.51	03/19/2014 00:45		03/19/2014 13:50	13.08	35.74							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	13	03/19/2014 05:15	03/19/2014 14:00	8.75	250	3,250	7.28	8.92				
4	21	03/19/2014 07:00	03/19/2014 17:45	10.75	250	5,250	6.80	7.82	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/19/2014 01:40	03/19/2014 16:40	15.00	502.3	33.5	502.3	436.4	86.90	1.08	0.18	0.59	0.101
4	03/19/2014 00:45	03/19/2014 19:10	18.42	507.6	27.6	507.6	333.73	65.75	0.72	0.18	0.48	0.035

R = Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.36	04/08/2014 15:30		04/08/2014 21:50		6.33	57.24						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)			Min (C°)	Max (C°)
PE	12	04/08/2014 16:10		04/09/2014 02:20		10.17	250	3,000	6.39	13.78		
2	23	04/08/2014 16:35		04/08/2014 21:00		4.42	250	5,750	9.43	13.44	R	
4	27	04/08/2014 16:35		04/08/2014 22:40		6.08	250	6,750	8.26	13.44	R	
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	04/08/2014 15:50	04/09/2014 02:20	10.50	148.7	14.2	148.7	148.7	100.00	1.09	0.00	0.63	0.103
2	04/08/2014 16:25	04/08/2014 22:00	5.58	N/A	N/A	N/A	N/A	56.7	0.79	0.18	0.41	0.045
4	04/08/2014 15:30	04/09/2014 00:45	9.25	N/A	N/A	N/A	N/A	76.06	0.53	0.18	0.37	0.016

R = Rejected because beginning of storm was not sampled and beginning of storm not sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
1.00	06/12/2014 21:40		06/13/2014 13:20	15.67	352.16							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	26	06/12/2014 21:55	06/13/2014 11:35	13.67	250	6,500	12.60	14.90	R			
2	17	06/12/2014 21:55	06/13/2014 07:00	9.08	250	4,250	N/A	N/A				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	06/12/2014 21:40	06/13/2014 12:40	15.00	539.4	36.0	539.4	340.68	63.01	1.24	0.18	0.66	0.144
2	06/12/2014 21:45	06/13/2014 07:45	10.00	196.6	19.7	196.6	179.9	91.50	0.91	0.18	0.41	0.065

R = Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
1.18	10/13/2014 19:50		10/14/2014 06:05	10.25	54.75							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	19	10/13/2014 20:35	10/14/2014 06:05	9.50	250	4,750	11.80	15.20				
2	23	10/13/2014 21:15	10/14/2014 03:45	6.50	250	5,750	N/A	N/A	R			
4	37	10/13/2014 21:05	10/14/2014 07:10	10.08	250	9,250	N/A	N/A	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	10/13/2014 20:05	10/14/2014 07:05	11.00	527.9	48.0	527.9	504.2	95.50	1.27	0.18	0.79	0.151
2	10/13/2014 20:55	10/14/2014 04:25	7.50	N/A	N/A	N/A	N/A	90.41	0.64	0.18	0.38	0.026
4	10/13/2014 20:40	10/14/2014 10:35	13.92	N/A	N/A	N/A	N/A	84.90	1.02	0.18	0.69	0.087

R = Rejected because beginning of storm was not sampled.

Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.41	03/31/2015 01:35		03/31/2015 04:15		2.67	40.25						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	11	03/31/2015 01:55	03/31/2015 04:30	2.58	250	2,750	8.80	11.20				
4	11	03/31/2015 03:40	03/31/2015 06:55	3.25	250	2,750	N/A	N/A	J			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/31/2015 01:45	03/31/2015 05:05	3.33	158.7	47.7	158.7	145.6	91.80	1.00	0.18	0.77	0.090
4	03/31/2015 01:40	03/31/2015 09:35	7.92	159.1	20.1	159.1	110.8	69.70	0.55	0.18	0.40	0.018

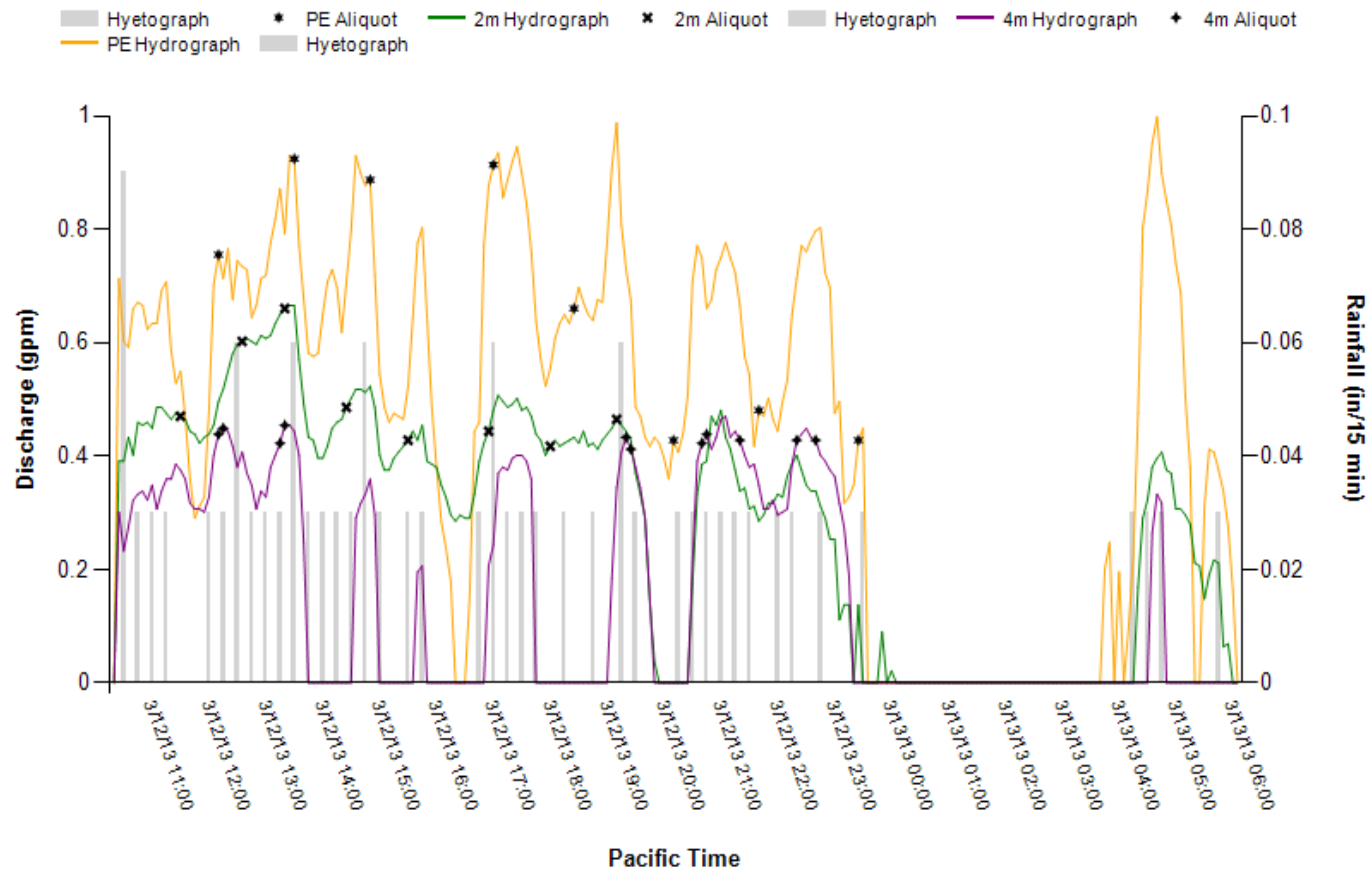
J=Estimate of Hydrology information

## Pilchuck MVFS

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.49	3/12/2013 10:20		3/13/2013 5:45	19.42	117.49							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	8	3/12/2013 12:10	3/12/2013 23:25	11.25	250	2,000	9.85	10.54	J			
2	8	3/12/2013 11:30	3/12/2013 19:10	7.67	250	2,000	9.85	10.54	J			
4	11	3/12/2013 12:10	3/12/2013 22:40	10.50	250	2,750	9.85	10.54				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/12/2013 10:25	3/13/2013 6:00	19.58	549.61	28.07	549.61	486.31	88.48	1.00	0.10	0.61	0.082
2	3/12/2013 10:25	3/13/2013 5:55	19.50	339.62	17.42	339.62	244.15	77.90	0.67	0.02	0.40	0.029
4	3/12/2013 10:25	3/13/2013 4:45	18.33	182.54	9.96	182.54	166.40	91.16	0.47	0.15	0.35	0.012

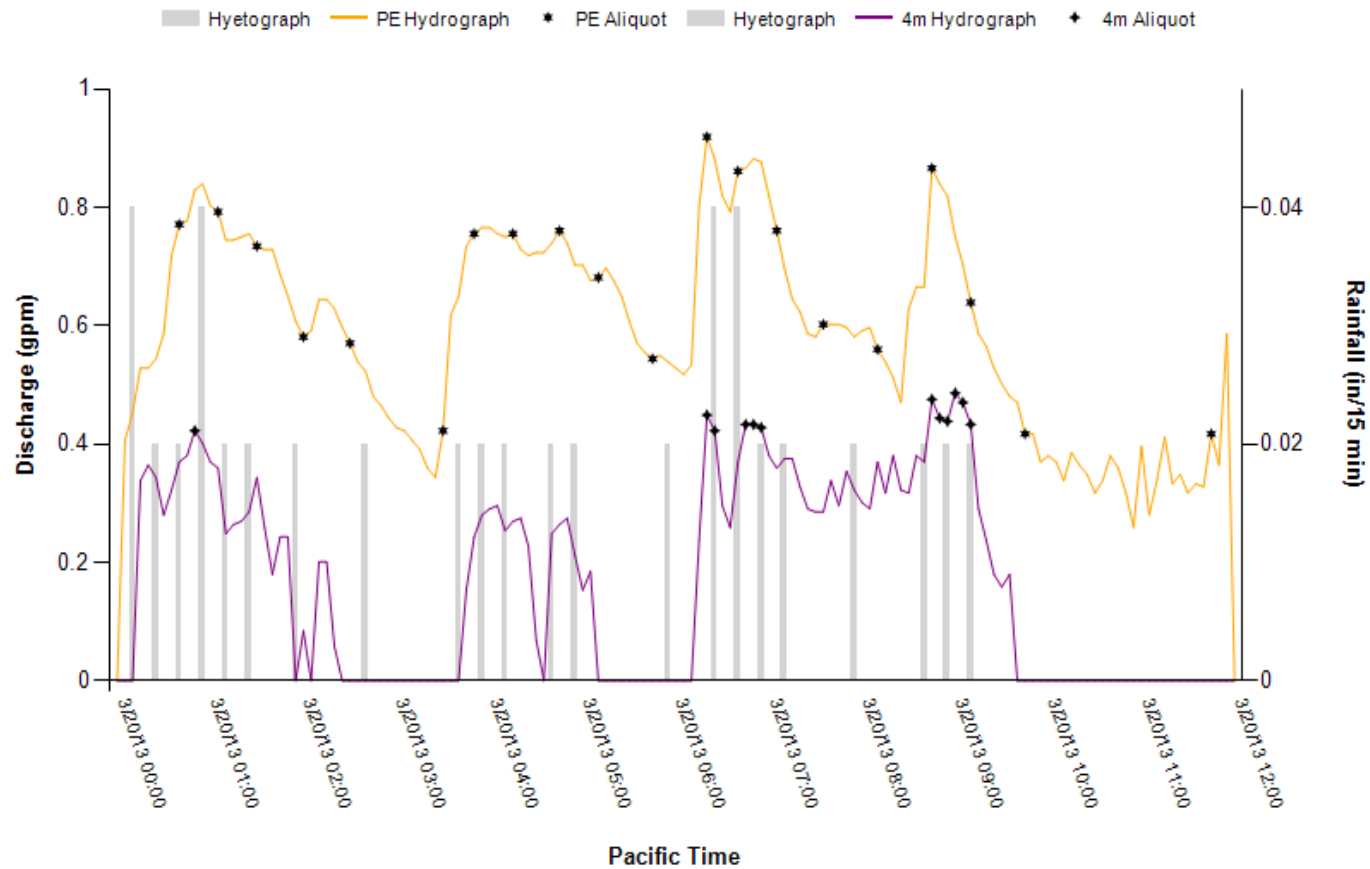
J=Estimate of Hydrology information.

## Pilchuck MVFS 3/12/2013 Storm Event



Precipitation												
Total (in)		Start Time		End Time		Duration (hrs)	Antecedent (hrs)					
0.26		3/19/2013 23:55		3/20/2013 8:55		9.00	41.74					
Aliquots								Water Temp		Validation Code		
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)			
PE	20	3/20/2013 0:35		3/20/2013 11:40		11.08	250	5,000	6.83	14.03		
4	12	3/20/2013 0:45		3/20/2013 9:05		8.33	250	3,000	6.83	8.87		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	3/20/2013 0:00	3/20/2013 11:50	11.83	424.08	35.85	424.08	419.32	98.88	0.92	0.26	0.59	0.066
4	3/20/2013 0:10	3/20/2013 9:30	9.33	123.42	13.23	123.42	118.19	95.76	0.49	0.06	0.30	0.013

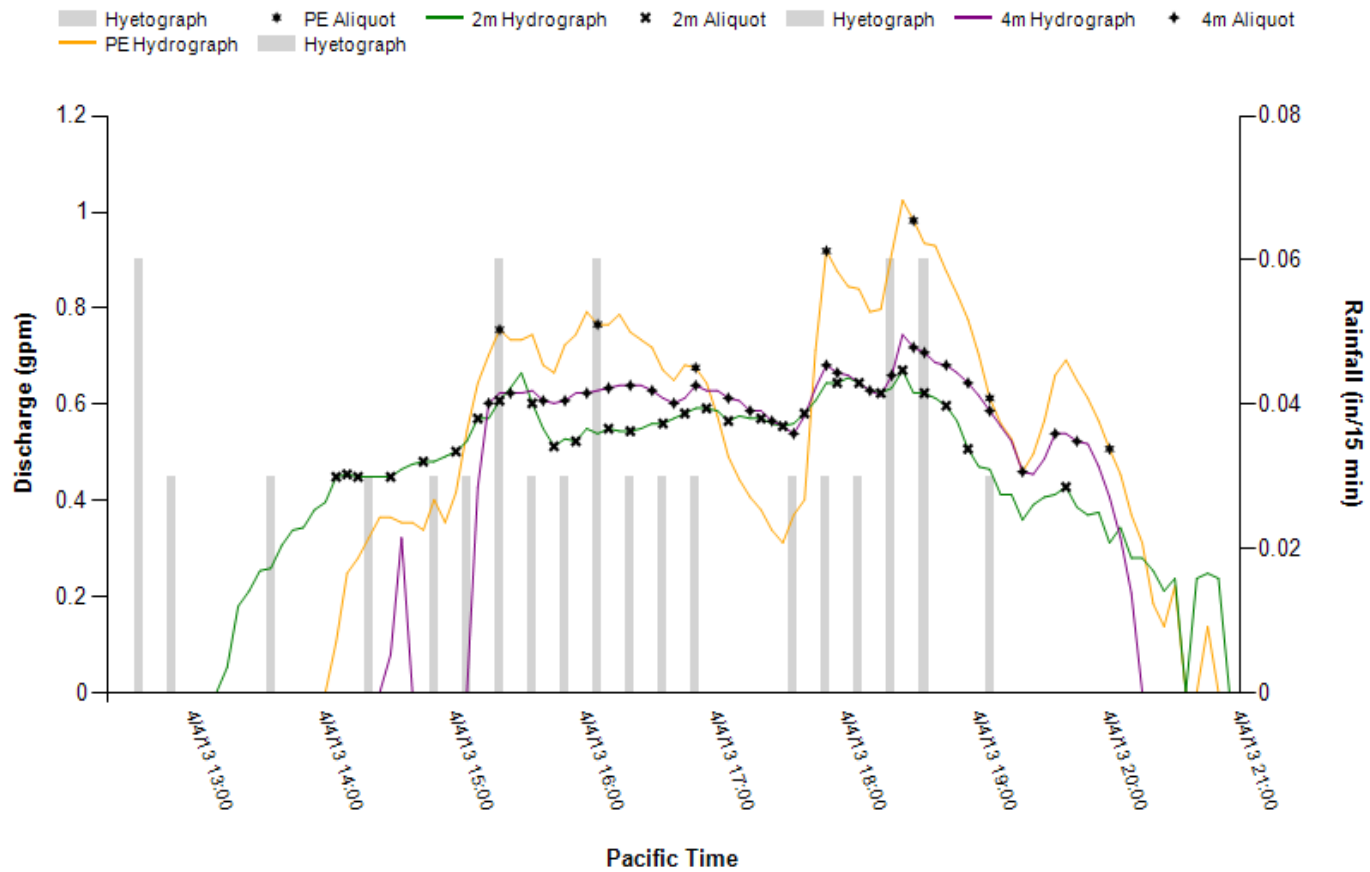
## Pilchuck MVFS 3/20/2013 Storm Event



Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.24	4/4/2013 12:25		4/4/2013 18:55		6.50	321						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)		Min (C°)	Max (C°)	
PE	7	4/4/2013 15:20		4/4/2013 20:00		4.67	250	1,750	12.25	12.65	J	
2	28	4/4/2013 14:05		4/4/2013 19:40		5.58	250	7,000	12.25	12.69		
4	26	4/4/2013 15:15		4/4/2013 19:45		4.50	250	6,500	12.25	12.65		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	4/4/2013 19:50	4/4/2013 12:25	7.42	424.08	57.15	232.13	223.04	96.09	0.57	0.14	-3.84	0.088
2	4/4/2013 13:15	4/4/2013 20:50	7.58	216.36	28.54	216.36	197.50	91.28	0.67	0.05	0.48	0.029
4	4/4/2013 14:30	4/4/2013 20:10	5.67	182.04	32.11	182.04	172.43	94.72	0.74	0.08	0.58	0.038

J=Estimate of Hydrology information.

## Pilchuck MVFS 4/4/2013 Storm Event



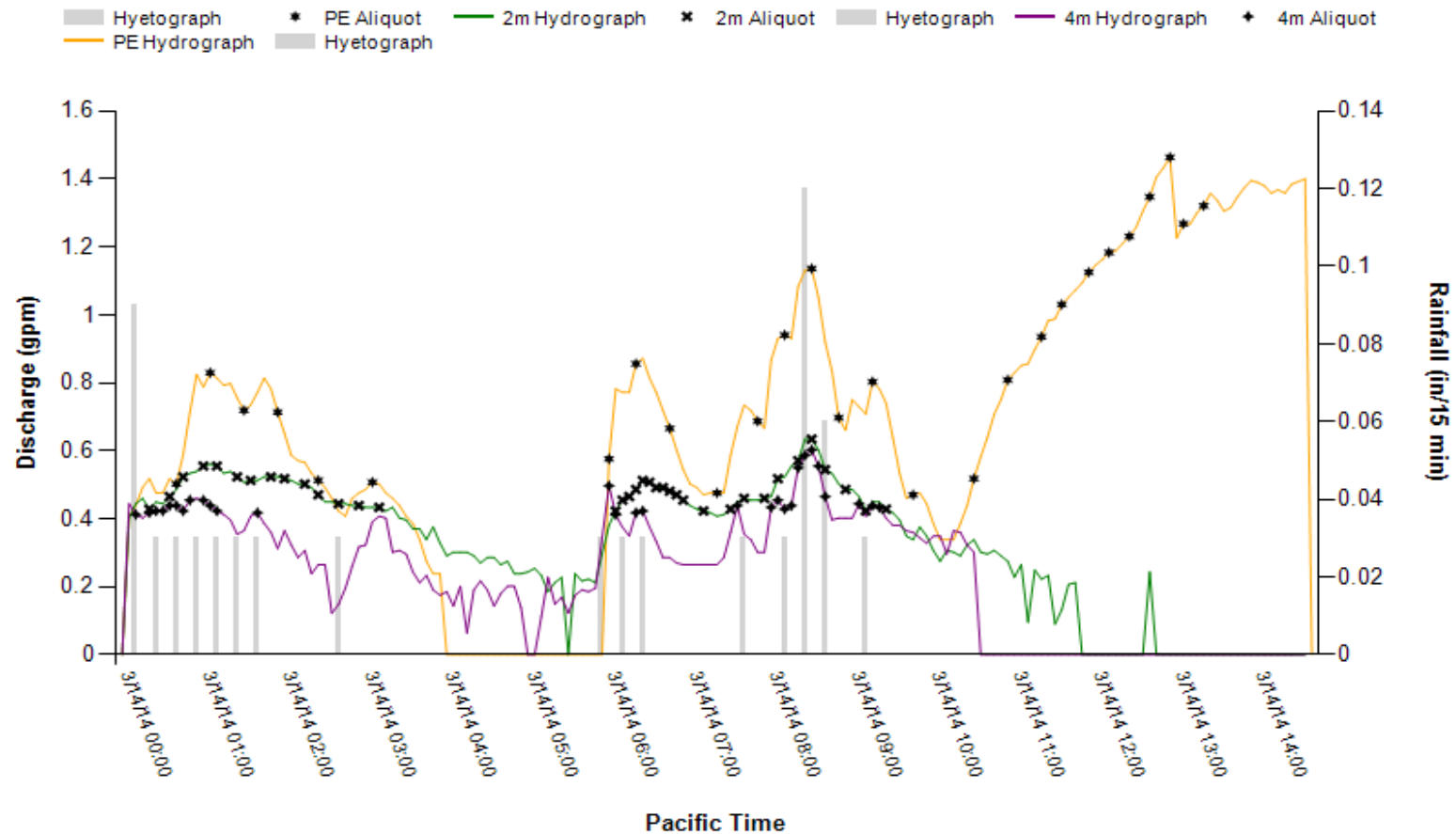
Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.63	01/28/2014 23:15		01/29/2014 15:15		16.00	372.5						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	37	01/28/2014 23:40	01/29/2014 11:35	11.92	250	9,250	5.78	8.81	R			
2	37	01/28/2014 23:40	01/29/2014 13:35	13.92	250	9,250	5.78	9.62				
4	27	01/29/2014 00:00	01/29/2014 14:10	14.17	250	6,750	5.78	9.82				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	01/28/2014 23:20	01/29/2014 16:15	16.92	1,138.5	67.3	1,138.5	884.3	77.70	1.45	0.23	1.12	0.214
2	01/28/2014 23:20	01/29/2014 19:15	19.92	407.9	20.5	407.9	342.8	84.00	0.62	0.07	0.36	0.024
4	01/28/2014 23:20	01/29/2014 15:25	16.08	271.5	16.9	271.5	250.5	92.30	0.58	0.07	0.41	0.020

R = Data is not reliable.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.22	03/13/2014 23:55		03/14/2014 09:05	9.17	91.99							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	27	03/14/2014 00:35	03/14/2014 13:15	12.67	250	6,750	8.20	18.16	J			
2	36	03/14/2014 00:15	03/14/2014 09:20	9.08	250	9,000	8.15	10.06	J			
4	34	03/14/2014 00:05	03/14/2014 13:20	13.25	250	8,500	8.15	18.16				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/14/2014 00:00	03/14/2014 14:30	14.50	596.4	41.1	596.4	501.1	78.37	1.46	0.24	0.79	0.219
2	03/14/2014 00:00	03/14/2014 12:35	12.58	279.6	22.2	279.6	226.47	80.99	0.63	0.09	0.40	0.025
4	03/14/2014 00:00	03/14/2014 10:25	10.42	203.3	19.5	203.3	178.77	87.95	0.60	0.06	0.33	0.022

J=Estimate of Hydrology information

### Pilchuck MVFS 3/14/2014 Storm Event

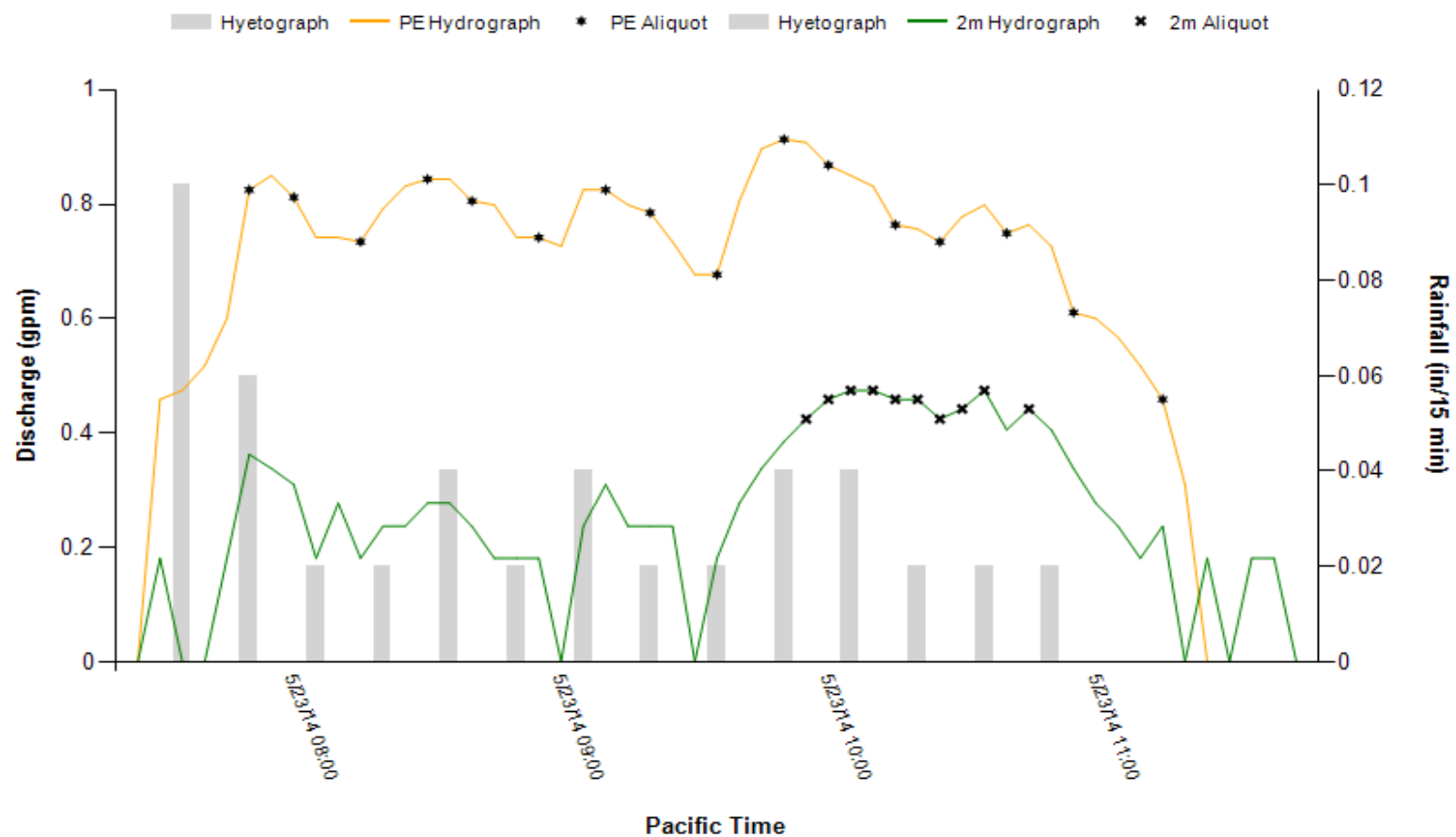


Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.50	03/19/2014 01:15		03/19/2014 13:55		12.67	39.49						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	37	03/19/2014 01:50	03/19/2014 15:45	13.92	250	9,250	6.19	9.08	R			
2	36	03/19/2014 01:40	03/19/2014 13:55	12.25	250	9,000	6.67	9.08				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/19/2014 01:20	03/19/2014 19:45	18.42	1,084.0	58.8	1,084.0	834.5	46.80	1.36	0.42	0.99	0.182
2	03/19/2014 01:20	03/19/2014 15:05	13.75	400.4	29.1	400.4	382.3	86.15	0.76	0.09	0.49	0.040

Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.24	05/23/2014 07:25		05/23/2014 10:45	3.33	97.83							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	16	05/23/2014 07:50	05/23/2014 11:15	3.42	250	4,000	13.30	15.20				
2	10	05/23/2014 09:55	05/23/2014 10:45	0.83	250	2,500	14.50	15.00				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	05/23/2014 07:30	05/23/2014 11:20	3.83	172.1	44.9	172.1	170.5	99.10	0.91	0.31	0.73	0.065
2	05/23/2014 07:30	05/23/2014 11:40	4.17	67.1	16.1	67.1	56.0	83.50	0.47	0.18	0.30	0.012

## Pilchuck MVFS 5/23/2014 Storm Event



Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.24	06/12/2014 21:40		06/13/2014 11:30		13.83	344.83						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)		Min (C°)	Max (C°)	
PE	31	06/12/2014 22:00		06/13/2014 11:45		13.75	250	7,750	12.80	15.10	R	
2	18	06/12/2014 21:55		06/13/2014 07:30		9.58	250	4,500	12.80	15.10	R	
4	15	06/12/2014 21:55		06/13/2014 07:30		9.58	250	3,750	12.80	15.10		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	06/12/2014 21:45	06/13/2014 12:50	15.08	639.5	42.4	639.5	614.4	51.38	1.32	0.24	0.70	0.169
2	06/12/2014 21:45	06/13/2014 11:45	14.00	207.2	14.8	207.2	171.0	72.50	0.78	0.18	0.41	0.043
4	06/12/2014 21:45	06/13/2014 08:15	10.50	155.1	14.8	155.1	140.5	83.90	0.76	0.18	0.42	0.040

Rejected because less than 75% of the hydrograph was sampled.

Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
1.13	10/13/2014 20:15		10/14/2014 06:10		9.92	55						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time		Last Aliquot Time		Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)		Min (C°)	Max (C°)	
PE	13	10/13/2014 20:55		10/14/2014 06:00		9.08	250	3,250	11.90	15.00	R	
2	17	10/13/2014 20:55		10/14/2014 03:30		6.58	250	4,250	12.40	15.00		
4	35	10/13/2014 20:55		10/14/2014 03:30		6.58	250	8,750	12.40	15.00		
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	10/13/2014 20:20	10/14/2014 06:30	10.17	491.0	48.3	491.0	309.42	63.01	1.33	0.24	0.84	0.170
2	10/13/2014 20:35	10/14/2014 04:40	8.08	152.9	18.9	152.9	135.0	88.30	0.64	0.18	0.36	0.026
4	10/13/2014 20:40	10/14/2014 05:05	8.42	235.0	27.9	235.0	187.93	79.97	0.83	0.18	0.46	0.051

Rejected because less than 75% of the hydrograph was sampled.

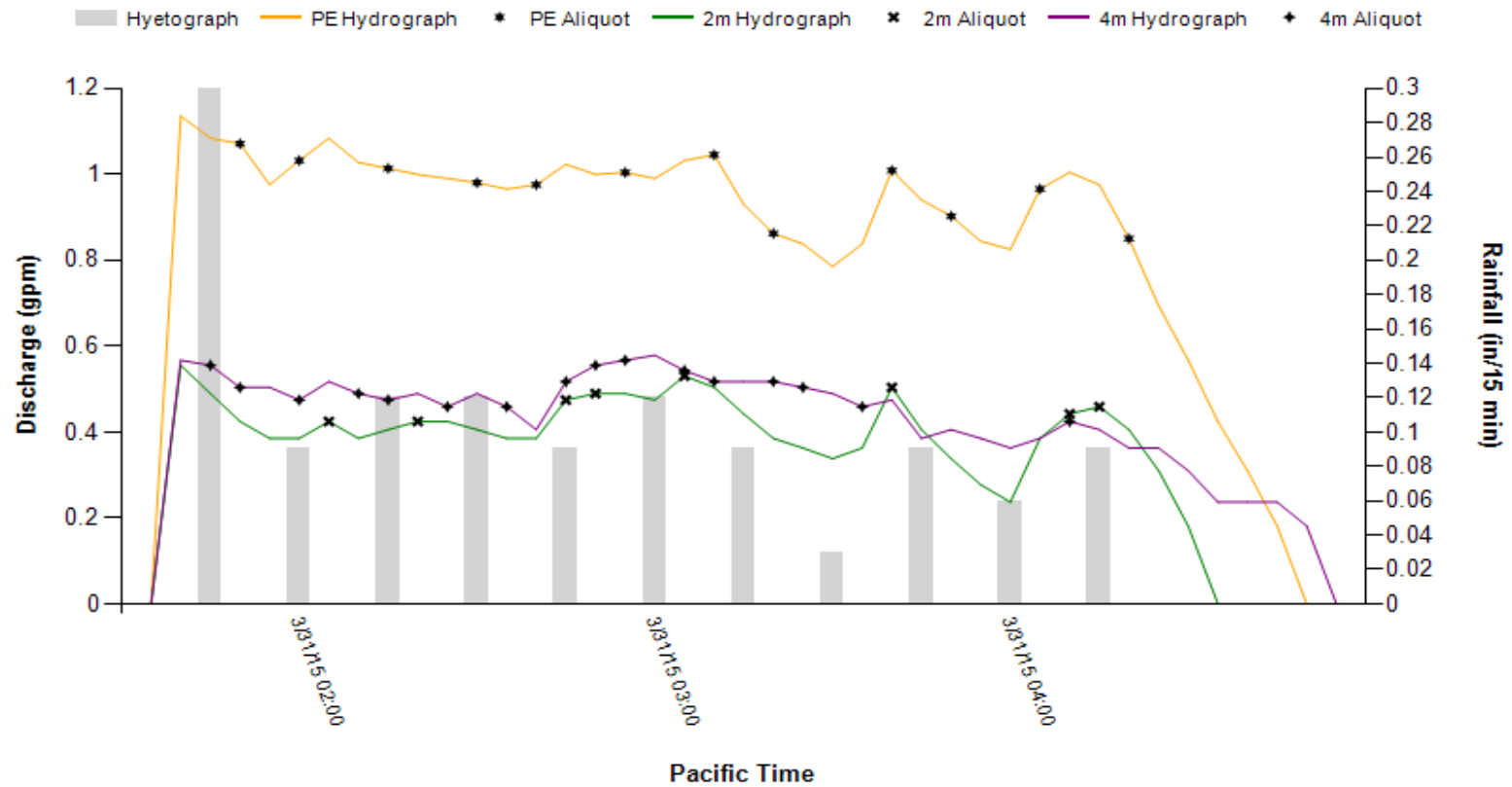
Precipitation												
Total (in)	Start Time		End Time	Duration (hrs)	Antecedent (hrs)							
0.14	12/18/2014 18:40		12/19/2014 00:05	5.42	14.33							
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	16	12/18/2014 22:35	12/19/2014 00:35	2.00	250	4,000	8.20	8.30	R			
2	9	12/18/2014 22:40	12/18/2014 23:20	0.67	250	2,250	8.20	8.30	R			
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	12/18/2014 22:30	12/19/2014 01:10	2.67	107.6	40.3	107.6	76.5	71.04	0.99	0.18	0.65	0.080
2	12/18/2014 18:40	12/19/2014 00:25	5.75	N/A	N/A	N/A	N/A	55.69	0.50	0.18	0.30	0.014

R = Rejected because less than 75% of the hydrograph was sampled and beginning of storm not sampled.

Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.40	03/31/2015 01:35		03/31/2015 04:15		2.67	40.16						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	10	03/31/2015 01:50	03/31/2015 04:20	2.50	250	2,500	9.30	11.60				
2	8	03/31/2015 02:05	03/31/2015 04:15	2.17	250	2,000	9.30	11.00	J			
4	15	03/31/2015 01:45	03/31/2015 04:10	2.42	250	3,750	9.30	11.80				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	03/31/2015 01:40	03/31/2015 04:45	3.08	170.9	55.5	170.9	137.11	80.24	1.14	0.18	0.90	0.114
2	03/31/2015 01:40	03/31/2015 04:30	2.83	71.4	25.2	71.4	66.9	93.70	0.56	0.18	0.41	0.018
4	03/31/2015 01:40	03/31/2015 04:50	3.17	86.5	27.3	86.5	69.98	80.86	0.58	0.18	0.44	0.020

J=Estimate of Hydrology information

## Pilchuck MVFS 3/31/2015 Storm Event



Precipitation												
Total (in)	Start Time		End Time		Duration (hrs)	Antecedent (hrs)						
0.71	08/14/2015 13:10		08/15/2015 03:40		14.50	450.41						
Aliquots							Water Temp		Validation Code			
Sample Point (m)	Aliquots Collected	First Aliquot Time	Last Aliquot Time	Sampling Duration (hrs)	Volume (mL)	Total Sample Volume (mL)	Min (C°)	Max (C°)				
PE	23	08/14/2015 13:35	08/15/2015 02:15	12.67	250	5,750	15.20	17.90	R			
2	37	08/14/2015 13:25	08/14/2015 19:20	5.92	250	9,250	16.60	17.90				
Runoff / Discharge												
	Runoff Time			Volume			Sampled		Flow			Stage
Sample Point (m)	Start Time	End Time	Duration (hrs)	Total (gal)	Intensity (gal/hr)	First 24Hrs (gal)	Discharge Total Volume Sampled (gal)	% Hydrograph Sampled	Peak (gpm)	Min (gpm)	Mean (gpm)	Max (ft)
PE	08/14/2015 13:15	08/15/2015 04:05	14.83	479.7	32.3	479.7	286.05	59.63	1.12	0.28	0.54	0.110
2	08/14/2015 13:15	08/14/2015 22:50	9.58	235.8	24.6	235.8	195.7	83.00	0.84	0.18	0.50	0.052

Rejected because less than 75% of the hydrograph was sampled.